PB82-201419

Background Document for the Financial Test and Municipal Revenue Test Financial Assurance for Closure and Post-Closure Care: Appendix A and B

(U.S.) Environmental Protection Agency
Washington, DC

Nov 81

U.S. Department of Commerce
National Technical Information Service
NTIS

PB82-201419

RESOURCE CONSERVATION AND RECOVERY ACT
SUBTITLE C - HAZARDOUS WASTE MANAGEMENT

Section 3004 - Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities

40 CFR Parts 264 and 265, Subpart H
Financial Requirements

BACKGROUND DOCUMENT FOR THE FINANCIAL TEST & MUNICIPAL REVENUE TEST FINANCIAL ASSURANCE FOR CLOSURE AND POST-CLOSURE CARE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF SOLID WASTE

November 30, 1981

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

50272-101

REPORT DOCUMENTATION PAGE

1. REPORT NO.

2.

3. Recipient's Accession No. PB82-201419

4. Title and Subtitle Background Document for the Financial Test Municipal Revenue Test Financial Assurance for Closure and Post-Closure Care and Appendix A and Appendix B

5. Report Date November 30, 1981

6.

7. Author(s) U.S. Environmental Protection Agency
Office of Solidwaste

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
U.S.E.P.A., OSW
401 M St. S.W.
Washington, D.C. 20460

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
U.S.E.P.A.
O. SW
401 M St S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The Background Document and Appendices describe the analysis and development the financial test for closure and post-closure-care financial responsiblity. Financial assurance is required to be established by owners or operators of hazardous waste management facilities under RCRA, Subtitle C Section 3004. The financial requirements can be found in 40 CFR Parts 264 and 265, Subpart H. The Background Document also explains why a municipal revenue test providing adequate assurance could not be developed.

17. Document Analysis a. Descriptors Background Document for Financial Test & Municipal Revenue Test Appendices A & B

b. Identifiers/Open-Ended Terms
Financial test;
Revenue test;
Municipal revenue test;
Closure and post-closure financial assurance;

c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report)

20. Security Class (This Page)

21. No. of Pages

22. Price

(See ANSI-Z39.18)

See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce

TABLE OF CONTENTS

Page

FINANCIAL TEST AND GUARANTEE FOR ASSURANCE OF CLOSURE AND POST-CLOSURE CARE, AND ANALYSIS OF REVENUE TEST

I. INTRODUCTION 1

- A. Organization of the Regulations 2
- B. History of the Regulations 3
- C. Description of the Regulations 4
- D. Key Definitions 9

II. BASIS FOR CONSIDERING A FINANCIAL TEST AS A MEANS OF ASSURING FINANCIAL RESPONSIBILITY 11

- A. Legislative Authorization 11
- B. Federal, State, and Local Precedents 13

III. SYNOPSIS OF PREVIOUSLY PROPOSED REGULATIONS 22

IV. ANALYSIS OF COMMENTS AND RATIONALE FOR STANDARDS 24

- A. General Analytic Approach 26
- B. Criticism of Test Components Proposed on May 19, 1980 84
- C. Suggested Alternative Components 90
- D. Applicability 98
- E. Level of Financial Assurance Provided 101
- F. Reporting Requirements 105
- G. Corporate Guarantee 116
- H. Revenue Test for Municipalities 120
- I. Other Issues 137

TABLE OF CONTENTS (Concluded)

Page

Bibliography 139

Glossary 145

Appendix A Evaluating the Effectiveness of Alternative Financial Tests

Appendix B Cost Analysis for a Financial Test

I. INTRODUCTION

Section 3004 of Subtitle C of the Resource Conservation and Recovery Act (RCRA) of 1976, Pub.L. 94-580 (October 21, 1976), requires that the Environmental Protection Agency promulgate regulations establishing such performance standards applicable to owners and operators of facilities for the treatment, storage, or disposal of hazardous waste as may be necessary to protect human health and the environment. Section 3004(6) states that these standards shall include requirements respecting "...the maintenance of operation of such facilities and requiring such additional qualifications as to ownership, continuity of operation,... and financial responsibility as may be necessary or desirable...."

The need for regulations establishing financial responsibility requirements for closure of hazardous waste treatment, storage and disposal facilities and for post-closure care of disposal facilities was addressed in the Preamble and Background Document accompanying the financial responsibility regulations promulgated on January 12, 1981, and the reader is referred to those documents.

The need for a financial test and corporate guarantee as optional methods of demonstrating financial assurance for closure and post-closure care was stressed by many commenters on the financial responsibility regulations proposed on December 18, 1978, and May 19, 1980. Those commenters argued that such provisions would achieve significant savings in costs to the regulated community and would at the same time satisfy the goals of RCRA. As a result of the study described in Chapter IV of this Background Document, the Agency believes that these mechanisms are effective means of assuring financial responsibility and that they will result in cost savings.

The fundamental objective of the financial responsibility standards is to ensure that funds will be available for proper closure of facilities that treat, store, or dispose of hazardous waste and for post-closure care of hazardous waste disposal facilities. (In the balance of this Background Document references to "closure and post-closure care" should be understood, unless otherwise indicated, to include closure alone, post-closure care alone, and closure and post-closure care.)

A. Organization of the Regulations

Financial responsibility requirements established pursuant to the Resource Conservation and Recovery Act (RCRA) of 1976, Pub.L. 94-580 (October 21, 1976) for owners and operators of hazardous waste treatment, storage, and disposal facilities constitute Subpart H of Parts 264 and 265 of Chapter 40, Code of Federal Regulations. Part 264 contains facility standards that will be used in the permitting process. Part 265 contains standards that apply to owners and operators with "interim status", i.e., their facilities were in existence as of November 19, 1980, they have notified EPA as required by Section 3010 of RCRA, properly applied for a permit, and are awaiting final administrative action on their permit applications.

Under the Subpart H regulations of both Parts 264 and 265, the owner or operator of each treatment, storage, or disposal facility must establish financial assurance for its closure. The owner or operator of a disposal facility must also provide financial assurance for post-closure care.

The regulations that this Background Document accompanies are included in Subpart H of Parts 264 and 265. They provide that a financial test and corporate guarantee may be used by owners or operators to establish financial assurance for closure and post-closure care.

The regulations do not include a revenue test for municipalities that was part of regulations proposed on May 19, 1980. This Background Document includes an analysis of the decision not to allow a municipal revenue test as a means of satisfying the financial assurance requirements.

B. History of the Regulations

The development of these regulations has been greatly influenced by public comments received on two sets of proposals. The first proposed regulation, issued December 18, 1978, allowed only trust funds as the means of assuring availability of funds for closure and post-closure care (43 FR 58995, 59006-7).

The EPA reanalyzed the issues raised by the commenters on this original proposal and other issues, and developed a second proposal which was published May 19, 1980. Alternatives to the trust fund for closure and post-closure care were proposed: surety bonds, letters of credit, a financial test, guarantees of the closure and post-closure obligations of one entity by another entity which met the financial test, a revenue test for municipalities, State guarantees of performance or funding, and State-required mechanisms if they were substantially equivalent to mechanisms specified in the regulations of Parts 264 and 265 (45 FR 33260-78).

In its proposal of May 19, 1980, the Agency invited comments on the proposed financial test, guarantee, and revenue test provisions (45 FR 33264-5). Extensive comments were received. Because of the complexity of the issues raised, the Agency could not complete its analysis in time to announce a decision regarding the financial test, guarantee, and revenue test on January 12, 1981, when it promulgated regulations establishing financial responsibility standards (46 FR 2821-29; 2851-2866). The Agency has now completed that analysis, including review of those comments received after January 12, 1981. The following chapters discuss the rationale for the regulation and the analysis of comments pertaining to the financial test, corporate guarantee, and revenue test for municipalities.

C. Description of the Regulations

1. Financial Test and Corporate Guarantee

A financial test has been developed to determine financial soundness of a company owning or operating a hazardous waste management facility for the purpose of assuring funds for closure, post-closure care, or both closure and post-closure care. Meeting this test is an alternative means of assuring funding of closure and post-closure care. In addition, a parent company passing this test would be allowed to guarantee funding for its subsidiary. The test requires that a company have net working capital and tangible net worth each at least six times the sum of current closure and post-closure cost estimates and tangible net worth of at least $10 million. Meeting two of the following three ratios is also required: total liabilities to net worth less than 2.0, sum of net income, depreciation, depletion, and amortization to total liabilities greater than 0.1, and current assets to current liabilities greater than 1.5. Specific reporting requirements must also be satisfied. An alternate test requires an investment grade bond rating issued by Standard and Poor's or Moody's, and tangible net worth greater than six times the sum of current closure and post-closure costs and tangible net worth of at least $10 million. Any firm passing either test must have at least six times current closure and post-closure costs in assets in the United States, or at least 90 percent of its assets in the United States.

The "current closure and post-closure cost estimates" referred to in the test criteria must include, first, all such estimates for facilities of which the firm using the test is the owner or operator and for which it is demonstrating financial assurance through the financial test of parts 264 of 265. Second, if the firm is providing one or more guarantees as specified in these regulations (see later discussion of corporate guarantee), the cost estimates of the facilities for which closure or post-closure care is being guaranteed must be included. Third, if the firm has facilities in States where EPA is not administering the financial requirements but the firm is demonstrating financial assurance to the State through a financial test equivalent or substantially equivalent to the test in Parts 264 and 265, the cost estimates covered by such tests must be included. Finally, if the firm is the owner or operator of facilities for which financial assurance for closure or required post-closure care is not being demonstrated, to a State or EPA, through the financial test or any of the other mechanisms specified in these regulations or equivalent or substantially equivalent State mechanisms, the closure and post-closure cost estimates for such facilities must be included. There are likely to be some facilities in this last category because, in the first phase of authorization of States to administer the RCRA regulations, States are not required to adopt requirements for establishment of financial assurance, although they are encouraged to do so. In later phases of authorization, States must have financial requirements equivalent or substantially equivalent to those in Parts 264 and 265.

The Agency's objective in these latter provisions is to assure that the sum of closure and post-closure costs against which the firm's financial condition is being tested through the financial test is complete. The sum should include all estimated closure and post-closure costs which the firm is obligated to cover, minus those covered by acceptable financial assurance mechanisms other than the financial test.

2. Reporting Requirements

In order to qualify for use of the financial test, a letter must be sent to the EPA signed by the chief financial officer of the firm containing the required data derived from the firm's independently audited, year-end financial statements for the company's most recently completed fiscal year. The letter must list all facilities and associated cost estimates as described above. The letter must be accompanied by a copy of the independent certified public accountant's report on examination of the firm's financial statements for the latest completed fiscal year, together with a special report from the CPA stating that he has compared the data set forth in the chief financial officer's letter with the amounts set forth in the financial statements, and no matters have come to his attention which cause him to believe that the specified data should be adjusted. If the accountant's opinion contained in his report on examination of the firm's financial statements is an adverse opinion or contains a disclaimer of opinion, the firm will not be allowed to use the financial test to comply with the financial responsibility requirements. The Regional Administrator may disallow use of the financial test based on other qualifications expressed in the auditor's opinion.

3. Corporate Guarantee

An owner or operator which is a subsidiary of another firm will be allowed to satisfy the financial responsibility requirements for closure and post-closure care by obtaining a parent company's written guarantee. In order to qualify as a parent corporation for this purpose, a firm must own at least 50 percent of the voting stock of the subsidiary firm which is the facility owner or operator.

The guarantor must meet the same requirements as the owner or operator using the financial test and has an independent contractual obligation to EPA. In effect, he "stands in the shoes" of the owner or operator, as far as assurance for closure or post-closure is concerned, through this guarantee. If the owner or operator fails to perform closure or post-closure care as required, the guarantor must do so or fund a trust in the full amount of the cost estimate in the name of the owner or operator. If the guarantor falls below the test criteria or is disallowed from continuing as a guarantor because of qualifications in the auditor's opinion of the guarantor's financial statements, the guarantor must provide alternate financial assurance in the name of the owner or operator if the owner or operator himself does not do so.

The cancellation provisions are comparable to those of the surety bonds and letters of credit. The guarantor must give a 120-day notice of cancellation to the owner or operator and the Regional Administrator by certified mail. If the owner or operator does not establish alternate financial assurance and obtain written approval of the assurance provided from the Regional Administrator within 90 days after the notice is received, the guarantor must provide such alternate assurance in the name of the owner or operator.

4. Revenue Test

After intensive study, the Agency has decided to withdraw the revenue test mechanism for municipalities because it does not appear to be an adequate means of demonstrating financial assurance of closure and post-closure care costs. Financially sound municipalities should be able to acquire the alternate mechanisms. The Agency believes State guarantess may be especially appropriate for closure and post-closure care at municipally owned or operated hazardous waste management facilities.

D. Key Definitions

When used in these regulations and the Background Document, the following definitions apply. All financial and accounting terms used for the purpose of complying with this regulation are intended to represent the common meaning of the terms as they are generally used in the business community.

(a) "Assets" means all existing and all probable future economic benefits obtained or controlled by a particular entity.

(b) "Current assets" means cash or other assets or resources commonly identified as those which are reasonably expected to be realized in cash or sold or consumed during the normal operating cycle of the business.

(c) "Current liabilities" means obligations whose liquidation is reasonably expected to require the use of existing resources properly classifiable as current assets or the creation of other current liabilities.

(d) "Independently audited" refers to an audit performed by an Independent Certified Public Accountant in accordance with generally accepted auditing standards.

(e) "Liabilities" means probable future sacrifices of economic benefits arising from present obligations to transfer assets or provide services to other entities in the future as a result of past transactions or events.

(f) "Net income" means revenues minus expenses for an accounting period, which is the net increase (net decrease) in owners' equity (assets minus liabilities) of an enterprise for an accounting period from profit-directed activities that is recognized and measured in conformity with generally accepted accounting principles.

(g) "Net working capital" means current assets minus current liabilities.

(h) "Net worth" means total assets minus total liabilities and is equivalent to owner's equity.

(i) "Parent corporation" means a corporation which directly owns at least 50 percent of the voting stock of the corporation which is the facility owner or operator; the latter corporation is deemed a "subsidiary" of the parent corporation.

(j) "Quick assets" means the working capital items that can be quickly converted to cash at close to their book value; generally, cash plus accounts receivable.

(k) "Tangible net worth" means the tangible assets of an entity that remain after deducting its liabilities; such assets would not include intangibles such as goodwill and rights to patents or royalties.

II. BASIS FOR CONSIDERING A FINANCIAL TEST AS A MEANS OF ASSURING FINANCIAL RESPONSIBILITY

A. Legislative Authorization

The Resource Conservation and Recovery Act of 1976 (RCRA) (P.L. 94-580) provides in Section 3004(6) that the EPA shall promulgate regulations, applicable to owners and operators of facilities for the treatment, storage or disposal of hazardous waste, "requiring such ... qualifications as to ... financial responsibility as may be necessary or desirable."

The Agency believes that the use of a financial test as a financial assurance mechanism is consistent with Congress' intent regarding acceptable means of assuring financial responsibility under RCRA.

Congress defined "financial responsibility" at least twice before the passage of RCRA. In 1966 it provided that:

> financial responsibility may be established by any one of, or a combination of, the following methods . . .: (1) policies of insurance, (2) surety bonds, (3) qualification as a self-insurer, or (4) other evidence of financial responsibility.[1]

Congress used the same definition again in legislation passed in 1972.[2] Congress placed no definition of financial responsibility in RCRA when it passed that law in 1976, or when it amended RCRA in 1980. However, Congress used the above definition of financial responsibility once again in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980,[3] which deals with many problems similar to those addressed in RCRA.

The Agency believes for several reasons that a financial test and corporate guarantee is an appropriate mechanism for the assurance of financial responsibility for closure and post-closure care requirements.

The plain meaning of the term "financial responsibility" does not preclude the use of a financial test or corporate guarantee. A common definition of responsibility is the ability to pay debts or meet business obligations.[4] Thus an assurance of financial responsibility might include any mechanism, including a financial test and corporate guarantee, that inspires confidence in the ability to pay debts or obligations.

In addition, the definition of financial responsibility previously approved by the Congress in 1966 and 1972 and inferred by the Agency to be applicable to RCRA includes, in the list of mechanisms authorized by Congress, "other evidence of financial responsibility." In its promulgation on January 12, 1981, of financial responsibility regulations for closure and post-closure care, the Agency adopted two mechanisms -- the trust fund and the letter of credit -- not specifically listed by Congress in this definition but clearly appropriate as "other evidence of financial responsibility." The Agency believes that a financial test and corporate guarantee is similarly appropriate.

In adopting these mechanisms, the Agency was aware that an important characteristic of financial responsibility for closure and post-closure care is that it is not contingent upon the occurrence of an unexpected harm. Closure and post-closure care are instead required activities which are certain to occur.

The Agency also recognized, however, that although its principal consideration in selecting the mechanisms was the effectiveness of each mechanism in assuring availability of sufficient funds when needed for closure and post-closure care, it might be necessary or desirable to balance other considerations against ready access to funds. Among those considerations are the avoidance of a capacity shortage in hazardous waste management, avoidance of unnecessary costs to the regulated community, the desirability of allowing flexibility in meeting the requirements, the administrative burden on the Agency, and the availability of the mechanisms. (See 46 F.R. 2822).

The Agency believes that the study described in this Background Document demonstrates that a financial test and corporate guarantee for closure and post-closure care can achieve the primary purpose of the financial responsibility requirement in RCRA and, at the same time, further some of the objectives listed above.

The Agency has therefore concluded, on the basis of both the language and the purpose of RCRA, that it possesses legislative authority to adopt a financial test and corporate guarantee as a means of demonstrating financial responsibility for closure and post-closure care.

B. Federal, State, and Local Precedents

In gathering information to use in developing financial requirements, EPA examined Federal, State and local requirements that have purposes similar to the closure and post-closure financial requirements. Review of these requirements provided not only precedents for the RCRA regulations but also alternative regulatory scenarios. It helped ensure that the experiences of other Agencies with financial instruments which might be appropriate were considered. In a few cases, information about experience in implementing these programs was valuable in pointing out the strengths and weaknesses of the various alternatives. The following is a summary of regulations which the Agency examined. Additional discussion of them can be found in Section IV.C. of this Background Document.

1. Federal Maritime Commission Regulations

The Federal Maritime Commission (FMC) has issued financial responsibility regulations under several different programs. Section 311(p) of the Federal Water Pollution Control Act (33 U.S.C. §466 *et. seq.*) requires vessel operators to demonstrate that they are "financially able to meet their liability to the United States resulting from the discharge of oil or hazardous substances" into waters over which the United States has jurisdiction (46 CFR §542.1(b)).[5] FMC regulations require vessel operators to select a financial mechanism approved by the FMC to prove that they will be able to meet potential obligations arising from spills. Such proof may be made by "any one of, or by an acceptable combination of, the following methods: Insurance; surety bond; qualification as a self-insurer; guarantee; and other methods" (§311(p) and 46 CFR §542.8(b)). Qualification as a self-insurer is accomplished by submitting balance sheets and other financial statements which show acceptable levels of working capital and net worth (46 CFR §542.8(a)(3)).

The FMC also has implemented regulations involving financial responsibility for losses suffered by passengers of vessels due to nonperformance[6] and for death or injury to passengers on voyages. These regulations allow a carrier to self-insure by providing proof that certain financial measures, such as working capital, net worth, credit rating, income and surplus are at a level acceptable to the FMC.

Finally, the FMC has promulgated regulations on financial responsibility for oil pollution of operators of vessels carrying oil which has been transported through the trans-Alaska pipeline[8] and of vessels operating in certain waters and engaged in transportation of oil produced from offshore facilities on the Outer Continental Shelf.[9] The former regulations may be satisfied through insurance, a surety bond, or maintenance in the United States of working capital and net worth in specified amounts. The latter regulations allow financial responsibility to be established through insurance, surety bonds, self-insurance, or a guaranty.

The FMC has advised the Agency that the most frequently used mechanism under both the oil spill and the passenger vessel regulations is insurance, followed by self-insurance, guarantees, and surety bonds.[10]

According to the FMC, their financial responsibility program has had no major problems. About 50 percent of the payments are from insurance companies and 50 percent from sureties, self-insurers, and guarantors. These percentages are roughly proportional to the numbers of vessels using these types of mechanisms. The amount of time it takes for a payment to be made varies widely. Some payments are immediate, while others require lengthy litigation. The latter situation, however, has been very rare. It has generally been more difficult to collect from self-insurers because they are giving up their own working capital. The FMC has found that the mechanisms easiest to administer are those for which it has standard forms--insurance and surety bonds. Self-insurers and guarantors become eligible by demonstrating net worth and working capital requirements on yearly balance sheets and auditors' statements. The financial statements are reviewed carefully by FMC staff who are expert financial analysts. There has been only one bankruptcy of a self-insured firm. In its submissions to the FMC prior to bankruptcy the company had solidly qualified as a self-insurer under the passenger vessel regulation. Although no passengers lost money, had there been injuries the firm may not have had enough assets to pay claims.[11]

2. Federal Surface Mining Regulations

The U.S. Department of the Interior issued regulations (30 CFR 800-809) in March 1979 under authority of the Surface Mining Control and Reclamation Act of 1977, (30 U.S.C. §§1201 et seq.) requiring that surface coal mining companies obtain a performance bond as certification that the mining activities will be conducted in accordance with certain performance standards. Performance bonds as defined in these regulations include: surety bonds; collateral bonds; escrow accounts; self-bonds; or a combination of the above. The regulations pertaining to self-bonds are currently being revised. A requirement that those electing self-bonding show net worth of $10 million and assets of $20 million is under consideration. Proposed regulations, as well as a study of self-bonding, are scheduled to be ready in 1981.[12]

3. U.S. Coast Guard Regulations

Under the Outer Continental Shelf Lands Act Amendments of 1978, (P.L. 95-372) the Coast Guard has issued regulations requiring coverage of liabilities that may result from oil spills (33 CFR Part 135).

Among other forms of financial responsibility, these regulations authorize the use of self-insurance. A party may qualify as a self-insurer by submitting a current balance sheet, income statement, and statement of changes in financial position, all certified by an independent Certified Public Accountant. In addition, a statement must be provided certifying that current U.S. assets exceed current U.S. liabilities and that net worth exceeds the amount of the requested self-insurance, or a statement showing that sufficient assets or cash flow will be available to retire a claim (33 CFR §135.213).

No detailed information is currently available concerning the effectiveness of these regulations.

4. Nuclear Regulatory Commmission Regulations

Persons licensed to operate nuclear reactors or to possess and use plutonium in a processing or fuel fabrication plant are required by the Nuclear Regulatory Commission (NRC) to provide "financial protection" for liability for injury or damage resulting from the hazardous properties of nuclear material. "Financial protection" is defined as "the ability to respond in damages for public liability and to meet the cost of investigating and defending claims and settling suits for such damages" (10 CFR §140.3(d)).

In addition to liability insurance, another means approved by the Nuclear Regulatory Commission is proof of "adequate resources to provide the financial protection required ..." (10 CFR §140.14(a)(2)). Such proof can be provided through the submission of annual financial statements for the three years preceeding the date of filing, together with an opinion on these statements of a Certified Public Accountant. The NRC may require additional proof if it desires. Apparently this provision has not been utilized by nuclear facility licensees. There is consequently no record of its effectiveness available.

The NRC is also developing regulations on financial assurance mechanisms for uranium mill reclamation, both for decommissioning and for long-term care after decommissioning, and for land disposal of low-level nuclear waste. The mechanisms currently under consideration include surety bonds, cash deposits, trust funds, deposits of government securities, escrows, letters or lines of credit, and combinations of those mechanisms, or such other types of mechanisms as may be approved. Self-insurance has not been found an acceptable mechanism, apparently because of the long term -- 100 years -- over which financial responsibility may have to be maintained.[13]

5. State Precedents

A majority of the States allow firms to use self-insurance for the purpose of assuring financial responsibility for liabilities to the employees of those firms under State workers' compensation laws. Although the Agency has not undertaken a comprehensive study of the individual State provisions, it has learned that frequent or common features of such provisions are minimum financial, size, and administrative standards, including minimum net worth requirements. States sometimes require self-insurers to obtain bonds for the performance of their obligations or to pay into solvency funds or to make security deposits.[14]

References for Chapter II

1. The Act of November 6, 1966 on Maritime Carriers, 46 U.S.C. §§817(d)(a) and 817 (e)(a).

2. Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. §1321(p.)

3. Pub. Law 96-510 §108(a)(1) (December 11, 1980). Congress has also, on at least two occasions following the passage of RCRA, defined "financial responsibility" to include a guarantee. Both the Outer Continental Shelf Lands Act Amendments of 1978 (43 U.S.C. §1811 *et seq.*) and the Motor Carrier Act of 1980 (P.L. 96-296 §30) provide that "Financial responsibility may be established by any one, or any combination, of the following methods: evidence of insurance, guarantee, surety bond, or qualification as a self-insurer." 43 U.S.C. §1815.

4. Black's Law Dictionary

5. *See generally* Staff of House Comm. on Public Works, 92d Cong., 1st Sess., *OIL POLLUTION AND FIANCIAL RESPONSIBILITY: A REPORT TO THE PRESIDENT AND THE CONGRESS FROM THE SECRETARY OF TRANSPORTATION* (Comm. Print 1971)

6. 46 CFR §540 Subpart A, issued pursuant to 46 USC §§817d(a) and 817e(a).

7. 46 CFR §540 Subpart B.

8. 46 CFR Part 543.

9. 46 CFR Part 544.

10. Memoranda on meetings between Federal Maritime Commission staff and EPA staff on financial responsibility requirements, November 16, 1979, March 7, 1980, and August 14, 1980.

11. *Id.*

12. Memorandum on meeting between EPA and Office of Surface Mining staff on February 28, 1980; 11 *Environmental Reporter: Current Developments* 2201.

13. Memorandum on contact between staff of EPA and staff of NRC Uranium Recovery Licensing Branch, July 30, 1980; Regulations issued by NRC Uranium Recovery Licensing Branch, 45 FR 65521 *et seq.* (October 3, 1980); Proposed Regulations issued by NRC Low-Level Waste Licensing Branch, 46 FR 38081-38105 (July 24, 1981).

14. Appleman, *Insurance Law and Practice* (Berdal ed.), §4601; National Commission on State Workmen's Compensation Laws, *Compendium on Workmen's Compensation*, 243-65 (1973).

III. SYNOPSIS OF PREVIOUSLY PROPOSED REGULATIONS

Requirements for financial responsibility for closure and post-closure care of hazardous waste management facilities were proposed on December 18, 1978 (43 FR 58995, 59006-7), reproposed on May 19, 1980, (45 FR 33260-78), and promulgated on January 12, 1981, (46 FR 2851-66, 1877-88). The reader is referred to the Preamble and Background Document for the reproposal for explanations of the differences between the reproposal and the original proposal, and to the Preamble and Background Document for the regulations promulgated on January 12, 1981, for explanations of the differences between those regulations and the reproposal.

In addition to those means of assurance of financial responsibility for closure and post-closure care that were promulgated on January 12, 1981, the May 19, 1980, reproposal also allowed the following means of assurance, which were not promulgated on January 12, 1981, because the Agency had not concluded its analysis of them:

Financial test and guarantee. By demonstrating financial strength, an entity would not be required to provide other assurances. The test criteria were: $10 million in net worth in the U.S.; a ratio of total liabilities to net worth of not more than 3; and net working capital in the U.S. twice the amount of the closure and post-closure cost estimates. An entity with these characteristics could guarantee closure and post-closure funds for another entity. These characteristics had to be demonstrated in quarterly audited financial statements containing unconsolidated balance sheets. If the company no longer met the criteria, it had to notify EPA within 5 days and establish other financial assurance within 30 days (45 FR 33268, 33272).

Revenue test for municipalities. If the owner or operator was a municipality, it could meet the requirements by having undedicated tax revenues amounting to 10 times the cost estimates. The municipality had to send a letter to EPA stating that it met this requirement. If revenues fell below the required level, the municipality had to notify EPA and establish other financial assurance within 30 days (45 FR 33268, 33273).

IV. ANALYSIS OF COMMENTS AND RATIONALE FOR STANDARDS

Comments on the proposed financial test and guarantee for financial assurance of closure and post-closure care, and comments on the revenue test for municipalities, the Agency's responses, and the rationale for the chosen actions are discussed in this chapter.

This chapter is organized as follows:

A. General Analytic Approach
  1. Possible Elements of Financial Tests
  2. Methods of Identifying Firms Which Will Later Go Bankrupt
    a. Effect of Firm Size on Failure Rates
    b. Ratio Tests
    c. Bond Ratings
    d. Alternative Methodological Approaches
  3. Methods of Identifying Firms Which Will Later Have Sufficient Ability to Pay
  4. Analysis of the Costs of Financial Tests
    a. Types of Costs Analyzed
    b. Overview of the Cost Model
    c. Costing Conventions
  5. Rationale for Standards
    a. Financial Test
    b. Limits to the Analysis
    c. Corporate Guarantee
    d. Revenue Test for Municipalities

B. Criticisms of Test Components Proposed on May 19, 1980, Financial Test

   1. Net Worth Requirement
   2. Working Capital Requirement
   3. Total Liabilities to Net Worth Ratio Requirement

C. Suggested Alternative Components for Financial Test

   1. Other Ratios
   2. Other Multiples
   3. Bond Ratings
   4. Other Suggested Alternatives

D. Applicability of Financial Test

   1. Request for Industry-Specific Criteria
   2. Industries Requesting Special Provisions
   3. Distinction Between On-Site and Off-Site Disposers

E. Level of Financial Assurance Provided

   1. Comparability to Alternative Financial Assurance Mechanisms
   2. Collateral Effects on Alternative Financial Assurance Mechanisms

F. Reporting Requirements for Financial Test

   1. Type of Financial Statements Required
   2. Time Schedule for Reporting
   3. Distinction Between Domestic and Total Resources

G. Corporate Guarantee

   1. Enforcement of Corporate Guarantee
   2. Terms of Corporate Guarantee

    3. Accuracy of Underlying Financial Data
    4. Need for Guarantee
- H. Revenue Test
    1. Likelihood of Municipal Default
    2. Municipal Ability to Shift Expenditures
    3. Suggested Alternative Municipal Tests
    4. Definition of Municipality
    5. Other Issues
- I. Other Issues

Unless otherwise specified, the discussions below refer to both Part 264 and Part 265. Also, the discussions of the financial test refer to its use for assuring both closure and post-closure care unless otherwise specified.

A. General Analytic Approach

The Agency received a variety of comments questioning the specific financial test proposed on May 19, 1980, or suggesting different test components or alternative tests. The Agency agreed with comments suggesting that a careful reanalysis and validation of the financial test and guarantee proposal should be performed. It therefore has conducted such a study. In its reanalysis of the financial test and guarantee, the Agency took into account the comments it had received.

This section of this Background Document first provides the general analytic approach used by the Agency, and then provides responses to the comments received by the Agency and the rationale for the actions chosen by the Agency.

The Agency's analysis proceeded in two steps. It first examined a large number of possible financial tests to determine how well they performed with respect to two related but dissimilar functions: passing firms that were capable of meeting their closure and post-closure obligations; and failing firms that would enter bankruptcy without meeting those obligations. The Agency then determined the relative costs associated with different tests and compared those costs with the costs associated with other mechanisms for assuring financial responsibility. A detailed description of the first step of the Agency's analysis is provided in Appendix A. Appendix B of this Background Document describes the Agency's determination of costs. These Appendices provide full analytic support for the numerical results reported in the following discussion.

In developing the financial test the Agency was particularly concerned with three general goals: (1) Funds should be available for closure and post-closure care for protection of human health and the environment. (2) As a matter of equity, the parties responsible for closure and post-closure obligations, i.e., owners and operators, should pay those costs. (3) Costs to the regulated community of providing financial assurance should be as low as possible. Thus, the Agency was concerned that the test chosen be effective, and in assessing the various possible test criteria it considered costs in selecting the elements of the test.

One particularly important feature of the development of the analysis should be noted. One element of the financial test originally proposed on May 19, 1980, was the requirement that a firm have over $10 million in net worth, and the analysis was originally limited only to those firms able to meet that requirement. In the course of the analysis, however, the Agency concluded that a requirement should be added that only independently audited firms could qualify to use the financial test. The analysis therefore proceeded on a somewhat revised basis, being conducted for those firms of over $10 million in net worth which are independently audited. The results in this Background Document are reported for independently audited firms. The Agency also conducted a special examination of the results for those firms of less than $10 million in net worth which are independently audited. The Introductions to Appendix A and Appendix B describe the analytic steps in greater detail and explain further the data in those Appendices.

1. Possible Elements of Financial Tests

A financial test should combine two types of elements to achieve two different purposes. Some elements should serve as indicators that the firm will not become bankrupt without meeting its closure and post-closure obligations. Other elements should demonstrate that if a firm ceases to pass a financial test, it will continue at that time to possess assets sufficient so that it will be able to pay the costs associated with financial responsibility. Both elements are essential to an effective financial test.

Many different types of indicators to perform these functions were suggested to the Agency. Financial data from balance sheets and income statements, multiples of those data, ratios which can be computed from those data, bond ratings, and expert opinions by trained financial analysts were the indicators most frequently suggested. The Agency analyzed the use of all of these suggested indicators. The results of the Agency's study are described in detail in the sections which follow.

2. Methods of Identifying Firms Which Will Later Go Bankrupt

The Agency began its analysis by determining the historical failure rates of all sizes and types of firms. Dun and Bradstreet statistical series (Dun and Bradstreet Corporation, The Business Failure Record, New York, 1979) indicate that the arithmetic mean of annual business failures over the post-1945 period is approximately 44 per 10,000 firms, of all those firms of whatever size, whether incorporated or not, reported upon by Dun and Bradstreet. The Agency used that figure as the baseline failure rate with which to compare the performance of the following selected indicators.

a. Effect of Firm Size on Failure Rates

The financial test originally proposed on May 19, 1980, required that a firm have over $10 million in net worth. Commenters suggested both higher and lower minimum net worth requirements, as well as recommending that the requirement be discarded. The Agency therefore examined the relationship between the size of firms, as measured by their net worth, and their failure rates. Because there is no large-scale data base on business failures by size of firm, precise quantification of the effect of the requirement was difficult and uncertain. However, a review by the Agency of the available data suggested that failure rates are in general lower the larger the firm. The specific choice of

$10 million in tangible net worth as a suitable cut-off point was most strongly suggested by a study by Dun & Bradstreet (cited in Backer and Gosman,1978) which provided data for failure rate by trade credit rating and tangible net worth. For those trade credit ratings with significant failure rates, the failure rate was sharply lower for those firms with over $10 million in tangible net worth than for firms with tangible net worth in the range of $1 to $10 million or in classes representing lower tangible net worth. A review of all data suggested that firms with over $10 million in tangible net worth had, at most, one-half the baseline failure rate, or approximately a failure rate of 22 per 10,000 firms. (For a discussion of the evidence on relation of firm size to failure rate, see Appendix A, Section II. In contrast, in those additional analyses conducted for firms of less than $10 million in net worth, the Agency assumed that because of the special problems associated with owning TSDFs which could themselves cause bankruptcy (e.g., high costs of cleanup and repair, liability judgments in excess of insurance coverage), and because of the historically demonstrated greater instability of small firms, firms of less than $10 million in net worth would have a higher than average failure rate. The Agency was also concerned that unless a $10 million in net worth requirement were established high administrative expenses would be incurred for examining the records of smaller companies to ensure their financial stability. (See Appendix B, Section IV.C.).

b. Ratio Tests

The financial test proposed on May 19, 1980, included a requirement that a firm have a ratio of total liabilities to net worth of not more than three. Several alternative or additional financial ratios were suggested by commenters. The Agency examined whether tests based on specific financial ratios were more effective in forecasting eventual bankruptcy than a single test of net worth, and sought to identify particularly useful financial ratios.

In order to evaluate the ratio tests, separate unmatched samples of bankrupt and non-bankrupt firms were developed. (Definitions of statistical terms and a detailed description of the industry sample and other statistical procedures are provided in Appendix A to this Background Document.) The Agency identified 66 bankrupt firms from previous bankruptcy forecasting literature and from independent research; all had total assets of greater than $1 million and had filed for protection under the Bankruptcy Act between 1966 and 1979. For non-bankrupt firms, 178 companies, identified by the industry index of Moody's Industrial Manual as members of industrial categories that generate and dispose of large quantities of hazardous waste on-site, were selected. Financial data on these companies was obtained for the three-year period 1973-1975. The recession year 1975 was deliberately included to evaluate the effects of business cycle fluctuations on financial ratio performance. This sample was designed to represent the average asset size range and mix of industries likely to seek to use a financial test. Both the bankrupt and non-bankrupt samples were then randomly divided into primary and "holdout" groups in order to control against sample bias.

Many commenters on the May 19, 1980 regulation suggested that electric utilities and hazardous waste management firms possessed unique financial characteristics and should be governed by a separate financial test. To test this suggestion, financial data for twenty-six utilities and two representative large hazardous waste management firms were also examined.

The Agency reviewed the existing literature on bankruptcy forecasting to identify those financial ratios that had been previously evaluated. In addition, it used the comments on the May 19, 1980 proposed regulation and the suggestions of bond rating experts and credit analysts to identify other candidate ratios. The list of ratios assembled was extensive and varied widely in content and estimated effectiveness. From this list, the Agency selected seven financial ratios for detailed evaluation:

- cash flow/total liabilities[1]
- net income/total assets
- total liabilities/net worth[2]
- current assets/current liabilities
- quick assets/current liabilities

---

[1] The term cash flow refers to the sum of net income, depreciation, depletion, and amortization.

[2] No distinction between tangible and intangible net worth was made with respect to this ratio.

- net working capital/total assets
- net sales/total assets

These ratios were chosen because they satisfied three basic conditions: (1) they produced significant predictive results in the prior literature, (2) they were frequently identified by bond rating services and credit analysts as key parameters, and (3) their values were readily available from corporate balance sheet data.

Financial ratios can correctly identify a very high percentage of future business failures, but only at the expense of incorrectly identifying some percentage of future non-bankrupt firms as bankrupt. Therefore, several measures of a test's predictive value were computed to provide a means for comparing test alternatives. They were designed to assess the public and private impacts of the various test options.

The most important of these measures of a test's overall predictive value was found to be the effectiveness measure (E), which represents the Agency's estimate of the number of firms (per 10,000 that pass a given financial test) that will go bankrupt without providing alternative financial assurance. The second major measure of the test's performance was the measure of the percentage of non-bankrupt firms that pass a given financial test (A_{NB}).

The effectiveness measure (E) was calculated according to the two-step procedure used by all previous bankruptcy studies that have derived effectiveness data. Such data are necessary to determine the best test for a particular purpose, such as, for example, to determine the costs of given tests. Figure 1 describes how E is calculated.

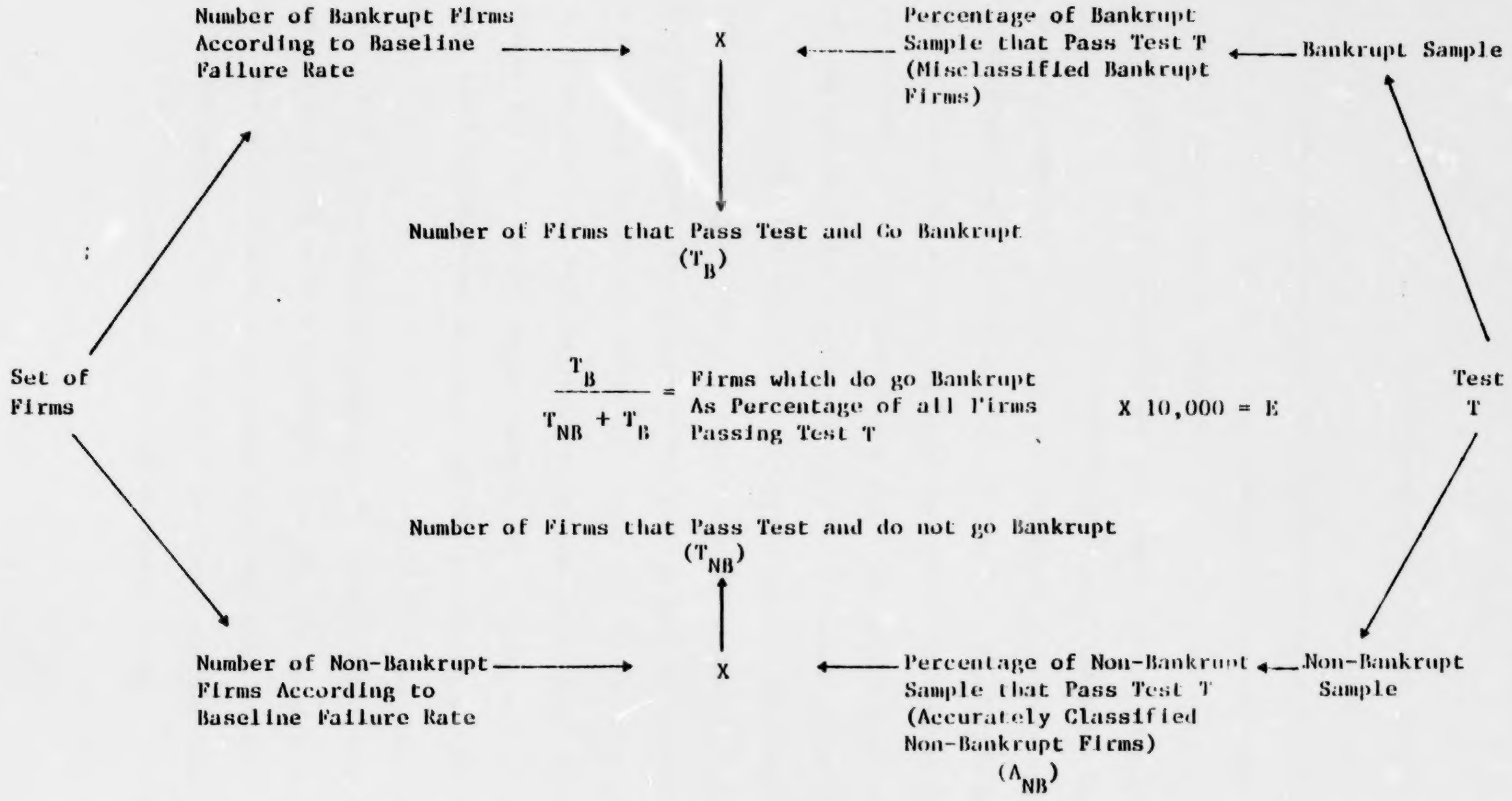

Number of Bankrupt Firms According to Baseline Failure Rate
X
Percentage of Bankrupt Sample that Pass Test T (Misclassified Bankrupt Firms)
Bankrupt Sample
Number of Firms that Pass Test and Go Bankrupt (T_B)
Set of Firms
$\frac{T_B}{T_{NB} + T_B}$ = Firms which do go Bankrupt As Percentage of all Firms Passing Test T
X 10,000 = E
Test T
Number of Firms that Pass Test and do not go Bankrupt (T_{NB})
Number of Non-Bankrupt Firms According to Baseline Failure Rate
X
Percentage of Non-Bankrupt Sample that Pass Test T (Accurately Classified Non-Bankrupt Firms) (A_{NB})
Non-Bankrupt Sample

FIGURE 1

PROCEDURE FOR CALCULATING THE EFFECTIVENESS (E) MEASURE

Each test was applied to both the bankrupt and the non-bankrupt firm samples. The results were then used to calculate the percentage of the bankrupt sample that passed the particular test (i.e., the percentage of bankrupt firms that were misclassified by that test as non-bankrupt), and also to calculate the percentage of the non-bankrupt sample that passed the particular test (i.e., the percentage of non-bankrupt firms that were accurately classified by that test as non-bankrupt).

At the same time, the Agency calculated how many, of a set of firms, could be expected to go bankrupt according to various baseline failure rates. This procedure yielded a number for firms that would go bankrupt according to the baseline failure rate, and a number for non-bankrupt firms according to the same baseline failure rate.

In the second step of this process, the Agency multiplied the number for bankrupt firms at a particular baseline failure rate by the percentage of bankrupt firms misclassified as non-bankrupt by a particular test. This operation yielded a number for firms that pass a particular test and go bankrupt.

Similarly, the Agency multiplied the number for non-bankrupt firms at a particular baseline failure rate by the percentage of non-bankrupt firms that are accurately classified as non-bankrupt firms by a particular test. This operation yielded a number for firms that do not go bankrupt and pass a particular test.

Finally, the Agency used these results to calculate what percentage of all firms passing a particular test are firms which will go bankrupt. (In Figure 1, this operation is represented by T_B divided by T_{NB} plus

T_B.) That percentage was then multiplied by 10,000 to yield the number of firms per 10,000 that pass a given financial test that will go bankrupt. This number, E, is the measure of effectiveness of a particular test. It can be reconverted to a percentage by dividing by 10,000.

The Agency's evaluation of various tests was also based on assumptions about the length of time that will be necessary to guarantee that a firm that no longer passes a financial test will still be able to establish an alternative financial assurance mechanism. Based on the Agency's analysis of the rate of deterioration in the liquid assets of failing firms, and its assessment of the potential for delays in litigation and enforcement, the following assumptions were made: (1) all firms which first fail a financial test at least three years prior to bankruptcy will provide alternative financial assurance, (2) one-half of those firms eliminated between three and two years prior to bankruptcy will set up alternative financial assurance mechanisms, and (3) no firms which first fail a financial test less than two years prior to bankruptcy will provide financial assurance. A more detailed discussion of these assumptions is included in Appendix B.

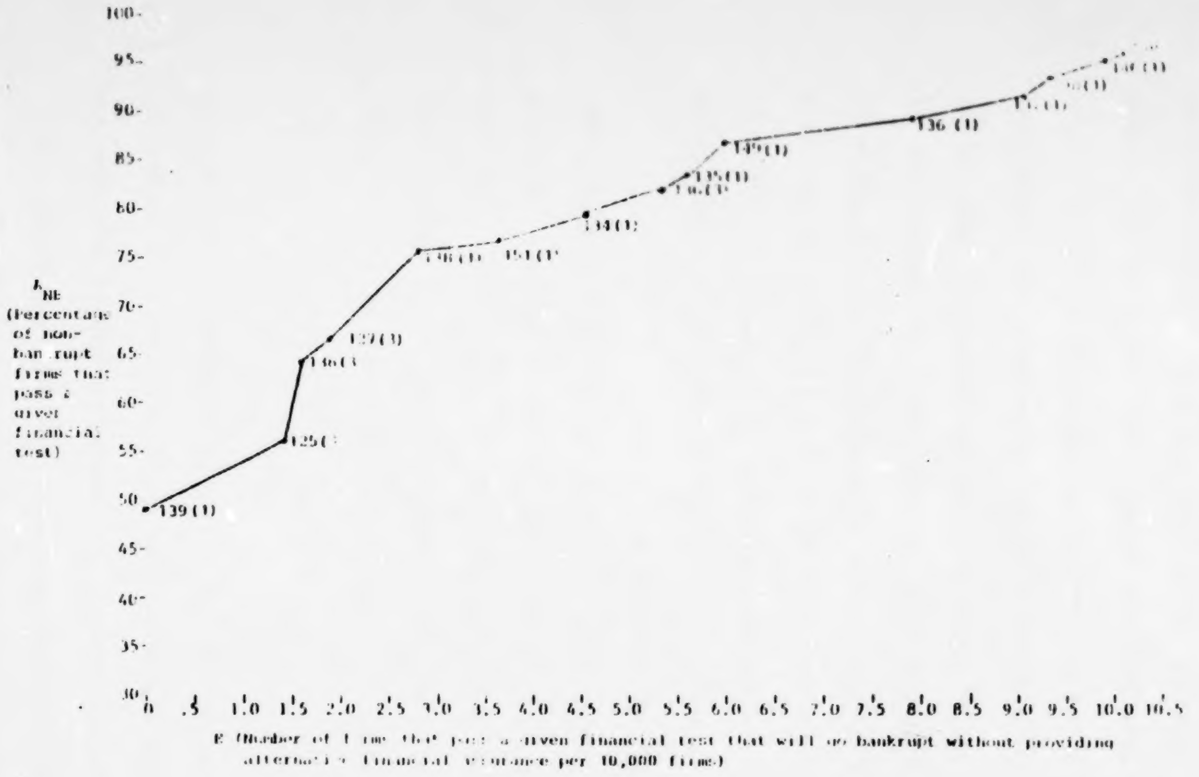
The seven financial ratios selected for evaluation were first tested individually against the primary bankrupt and non-bankrupt firm samples, using a variety of pass-fail cutoff points derived from the bankruptcy forecasting literature for each variable. The most promising ratios were then combined together to form 120 alternate multi-ratio tests, which were then retested against the primary sample. The ratios were combined in three ways: two-ratio tests (firms must pass both elements of the test to pass), three-ratio tests (firms must pass all three elements of the test to pass), and three-ratio contingent tests (firms must pass two of three elements to pass). Twenty-nine of the multi-ratio tests produced E results (2.2 firms per 10,000 that will fail without providing alternative assurance) that were approximately 90 percent lower than the baseline failure rate (22 per 10,000 firms) for firms independently audited. However, these increases in efficiency in classifying bankrupt firms were largely obtained by excluding increasingly high percentages of viable firms (defined as firms that will not go bankrupt within three years). Alternatively, 17 of the multi-ratio tests evaluated permitted more than 80 percent of the non-bankrupt firm population to pass the financial test; these tests were able to reduce the undetected failure rate to between 6.3 and 11.4 firms per 10,000 for large firms.

Consequently, a second phase of the testing exercise was undertaken to determine whether other financial ratios could be added to these tests to improve their ability to discriminate between viable and non-viable firms, while retaining the same high levels of bankrupt firm detection. Ten ratios were tested for their ability to correctly classify 32 non-bankrupt and 12 bankrupt firms that had been consistently misclassified by the original tests. One ratio, the ratio of net fixed assets/total assets, greatly enhanced predictive accuracy. To test the validity of this ratio against the entire primary sample, the Agency evaluated 31 new tests including this ratio.

Using the E and A_{NB} results obtained from evaluating tests against the primary sample, the Agency generated performance curves for all of the tests analyzed. Any test falling on one or more of the performance curves was considered to be a "best test," and was then evaluated against the holdout sample, to control for sample bias. The holdout results generally confirmed the results obtained from the primary sample. Comparison of the average financial characteristics of the primary sample with the characteristics of samples developed for other studies supported the conclusion that the primary sample results represented a conservative, lower-bound estimate of likely test effectiveness.

In examining the performance of possible tests, the Agency examined each test based upon one-year and three-year eligibility requirements. A one-year eligibility requirement allows a firm to use a financial test in a given year if it met the requirements of the financial test for its financial statement of the previous year. A three-year eligibility requirement requires a firm to have passed the financial test for three consecutive years prior to being allowed to use a financial test instead of another financial mechanism. Figure 2 provides a summary of the best test results.

The Agency also examined the question of industry differences in test performance, particularly in regard to those industries (primarily electric utilities and hazardous waste management firms) that had previously objected to the use of certain financial test formats, on the grounds that a given financial test may serve quite well for most industries, but unique characteristics of a specific industry may cause a



Source: Appendix A, Figure V-4.

Reproduced from best available copy.

FIGURE 2

PERFORMANCE CURVE OF BEST FINANCIAL TESTS WITH EITHER ONE-YEAR OR THREE-YEAR ELIGIBILITY REQUIREMENTS high percentage of the viable firms in that industry to fail a given test. Although some industry differences in ratio performances were encountered they were generally not significant, and a number of the best tests (especially those at the less stringent end of the spectrum) were found to be acceptable measures of performance for all industries, particularly when the ratio tests were supplemented by a bond rating test. The Agency concluded that problems both of design and of administration rendered unfeasible the development of tests tailored to different industries. A fuller discussion of the performance of tests for all manufacturing industries, including percentages of firms in particular industries which pass or fail various test criteria, is included in Section VI.A. of Appendix A.

A comparison of the results obtained by the Agency with other bankruptcy forecasting studies published in the literature indicated that the results of the "best" Agency tests are comparable to the best results obtained by previous forecasting efforts. The Agency tests would also be less difficult to administer. (See Section V.D. of Appendix A of this document.)

c. Bond Ratings

Several commenters on the May 19, 1980 proposed regulation suggested that bond ratings should be used as an alternative or substitute for the proposed financial test. The Agency therefore analyzed the possibility of using bond ratings as a financial test. A fuller discussion of bond ratings is included in Section VII of Appendix A.

Bond ratings provide an appraisal of the ability of firms to repay specific long-term debts. They therefore are more useful than credit ratings, which are primarily evaluations of ability to repay short-term credit and trade credit. The Agency considered whether bond ratings could be used in a financial test in either of two ways: as the sole criterion, or as a supplement to a financial test. Because ratings tend to be limited to firms that issue large quantities of publicly held debt, their use as the sole basis of a financial test would eliminate many substantial firms which do not have bond ratings but do have assets and net worth adequate to cover the costs of closure and post-closure.

The Agency determined, however, that as a supplement to a financial test, bond ratings could provide a useful method that firms could use to demonstrate their financial responsibility. Although firms with rated bonds are a small subclass of all firms, the Agency's study showed that few firms with rated bonds fail. The Agency noted, for example, that none of the 66 firms in its sample of bankrupt firms had an investment grade rated bond and few had ever issued a major bond offering. A variety of industry-specific problems also could be overcome, since bond ratings involve the application of judgment and expertise to a specific firm.

The Agency's conclusion was based on a study of the available data concerning bond ratings. Although the nationally recognized rating services assert that ratings provide a useful indicator that a firm will not become bankrupt, numerical data on the effectiveness of these ratings are difficult to find. The Agency conducted a literature search which found only one quantitative study of the performance of agency ratings of the bonds of private entities. This study is somewhat dated, covering the period 1900-1943, but it does examine a period of economic volatility which provides a good test of the results of ratings services.

Table 1 shows the performance of ratings for the period 1900 to 1943 according to this study. The ratings used are those assigned at the time of issue; thus, if the bond was downgraded prior to default but after issue, this would not be reflected in these performance indicators. Given the volatility of the economy for the period in question, and the fact that changes in rating were not accounted for, this Table presents a strict judgment of bond ratings. The Agency translated the accuracy of the bond ratings under alternative assumptions about the failure rate into the measure of effectiveness (E) used by the Agency to represent the number of firms (per 10,000 that pass a given financial test) that will go bankrupt without providing alternative financial assurance. (See the portion of Table 1 labeled "Effectiveness in Predicting Defaults.") The first assumption is the failure rate of 22 per 10,000 that the Agency estimated is the rate for firms of over $10 million in net worth. The second reflects the possibility that the failure rate for the kinds of firms which would have rated bonds might be as low as 11 per 10,000. The Agency based this lower estimate on the fact that public bond ratings are generally given to bond issuances from substantial firms. The numerous large public bond issues which are not rated at all have a much higher failure rate than the failure rate of

TABLE I

PERFORMANCE OF AGENCY RATINGS (1900-1943)

Agency Rating	Percentage of Defaulting Firms With Rating	Percentage of Nondefaulting Firms With Rating	Effectiveness in Predicting Defaults Per 10,000 Firms Assuming[1/]	
			Baseline Failure Rate = 22/10,000[2/]	Baseline Failure Rate = 11/10,000
A. All Corporate Bonds Rated (Industrials, public utilities, railroads)				
I	6.6	19	7.6	3.8
II or above	17.1	46	8.5	4.3
III or above	44.3	74	13.0	6.5
IV or above[3/]	72.5	94	16.8	8.3
B. Industrials Only				
I	0	13	0	0
II or above	5	33	3.3	1.7
III or above	28	66	9.5	4.7
IV or above[3/]	73	93	17.3	8.6

[1/] Calculated as for Effectiveness Calculation in Appendix A.

[2/] The baseline failure rate of 22 per 10,000 is the failure rate for firms with greater than $10 million in net worth. Firms with less than at least $10 million in net worth are assumed not to receive bond ratings.

[3/] Agency ratings of IV or above represent investment grade bonds.

SOURCE: Appendix A, Table VII-2.

those which are rated. The unrated issues are excluded from the entire rating system, and from the percentages shown in this Table.

There is no equivalent study for the post-war period on the performance of bond ratings. The basic reason for the absence of further and more recent research on this question is the very low default rate on large bond issues in the post-war period. One study found that the default rate for all large corporate bond issues, including privately placed issues, for the period 1944 to 1965 was approximately one-twentieth of that for the period 1900 to 1943. Half of the defaults in the 1944-1965 period were in the transportation industry, particularly the railroad sector. Defaults have therefore been such rare events that statistical assessment is meaningless. In gathering data on bankrupt firms for this study, the Agency found very few failures by firms with rated bonds, and only two failures by firms with a bond rating of investment grade or better within three years of default (W.T. Grant and Penn Central, which were not included in the bankrupt firm sample because they were in industries considered unlikely to dispose of hazardous waste). The percentage of firms assigned ratings below investment grade is 5 to 10 percentage points lower throughout the post-war period than in the 1900-1943 period, but this is viewed by most observers of the bond market as an indication of the improved quality of public offerings and of the tendency of firms that would receive ratings of less than investment grade to place bonds privately. The Agency has concluded, on the basis of the work of most financial analysts who have written about this subject, that bond ratings continue to be at least as accurate as they were over the 1900-1943 period. A fuller discussion of the performance of bond ratings is included in Section VII of Appendix A.

d. Alternative Methodology Approaches

The Agency was aware that alternative methodological approaches could have been used for the above study. EPA is satisfied, however, that those alternatives would not have yielded superior results. Moreover, some of the alternatives were not feasible. (A discussion of these alternatives is included in Section V.D. of Appendix A.)

The Agency's study examined financial tests that required specific financial ratios to be certain levels. An alternative approach would have been to use financial test that consisted of linear or nonlinear functions of a set of financial ratios. Three methods have been proposed in the literature for developing financial tests that consist of functions of financial ratios. One approach is simply to rely on expert judgment to decide what ratios should be included and what values should be associated with them. However, there is no statistical method of determining whether the values or the financial ratios chosen have been appropriately determined. A second approach is to develop a functional model of the factors that lead to business failure and to use this model to estimate the probability of business failure for any specific firm. This approach has been attempted once in the literature reviewed for this study, and that attempt did not include any statistical validation of the model. Considering the relatively short time available in which to analyze the financial test, the Agency decided not to attempt to develop an untested technique that might, in the end, not be effective or satisfactory. The third approach, and that most commonly used in the bankruptcy forecasting literature, is that of multi-discriminant analysis. This is a statistical search technique for arriving at the best linear or nonlinear function for a set of chosen financial ratios for discriminating between bankrupt and non-bankrupt firms. This is the most statistically sophisticated approach to the problem. The use of this approach was rejected in this study for two reasons: (1) a function of financial ratios would be more difficult to compute, more difficult to administer, and more difficult to check quickly than a simple set of ratio requirements; and (2) it has been pointed out several times in the literature on bankruptcy forecasting that although multi-discriminant analysis is statistically more sophisticated than other approaches, it has not in fact yielded more accurate forecasts of bankruptcy than the simpler approach adopted here. As a check of the validity of the procedures adopted, the Agency compared the results of the financial tests it developed to financial tests developed in bankruptcy forecasting studies employing multi-discriminant analysis. As noted above, the results obtained by the "best" Agency tests are comparable.

In developing its statistical sample, the Agency also chose not to attempt to gather a large population of firms, determine which ones had later entered bankruptcy and which ones had not, and then examine tests against this entire sample for their ability to forecast bankruptcy. The problem with this procedure is that bankruptcy is a relatively rare event. The average business failure rate in the post-war period has been approximately 44 per 10,000 firms per year, of all firms of whatever size, whether or not incorporated. In order to obtain a sample of bankrupt firms as large as that used in this study, it would have been necessary to obtain data on a total of 15,000 firms. Such an effort would not have been feasible, and had not been attempted in any previous study of bankruptcy forecasting.

Finally, a number of commenters felt that it would be advantageous to have specific tests for different industries. This approach could not be tested, however, because of the difficulty of gathering a large sample of bankrupt firms. An extensive search for firms which had gone bankrupt and which had publicly available financial statements yielded a total of 95 firms. Several of these were retail firms and therefore not appropriate for this study. None of these firms were electric utilities. To further subdivide this sample, for example, into two-digit SIC codes would result in samples of bankrupt firms too samll to be statistically usable. Thus, industry-specifc tests cannot be developed from the data currently available. A review of the bankruptcy forecasting literature found only one study which had developed industry-specific tests. This study, which was of the railroad industry, had to use bankruptcies over a period of 50 years in order to develop adequate sample size.

3. Methods of Identifying Firms Which Will Later Have Sufficient Ability to Pay

In addition to identifying firms that may go bankrupt, an adequate financial test should also provide assurance that at the time a firm ceases to pass the financial test, it will continue possess assets sufficient so that it is able to pay for closure and post-closure costs. Otherwise, it is possible that the attempt to pay these costs will be sufficient to force the firm into bankruptcy before these closure and post-closure costs have been fully paid. In such a case, the balance of the costs would have to be claimed by the EPA in the bankruptcy proceeding, which could be a time-consuming and sometimes ineffective process that the Agency wishes to avoid if possible.

To evaluate this ability to pay question, the Agency reviewed financial data for twelve bankrupt firms which were especially difficult to classify because their financial condition had deteriorated very rapidly in the two to three years prior to their declaration of bankruptcy (see Section II of Appendix A). The Agency analyzed the ability of these firms to pay three, two, and one years prior to their bankruptcy. The Agency's review of their financial statements revealed that eleven of the twelve firms retained significant amounts of cash and liquid assets, positive net working capital, and positive net worth two years prior to bankruptcy, and two-thirds of these firms continued to meet these conditions one year prior to bankruptcy. Additional data about bankrupt firms generally confirmed the accuracy of these results. Although this demonstrated the general availability of cash and capital resources to fund the establishment of an alternative form of financial assurance, other factors were noted (negative cash flow, rapid deterioration of working capital) which could threaten the Agency's ability to secure these resources. In order to avoid the occurrence of such problems under a financial test provision, the Agency determined that the best approach would be to specify certain minimum levels of net working capital and tangible net worth (defined as multiples of the firm's closure and post-closure estimate) that would have to be met as part of any test selected.

The multiples of these financial variables required to ensure the ability to pay were calculated for the twelve sampled firms. The results indicated that a multiplier of six would be appropriate to ensure the presence of the necessary funds.

The factor of six was determined by combining two judgments. The Agency concluded first that net working capital and tangible net worth of at least twice the estimated closure and post-closure costs would have to be present at the time the funds were paid, to ensure that such payment did not put the firm into a negative net working capital and negative net worth situation. Secondly, the Agency concluded that it was necessary to provide against rapid deterioration in tangible net worth and net working capital during the period between the determination that a firm no longer passed the financial test and the time that the necessary funds could be collected from the firm. Such delays could occur, for example, because of legal proceedings. Analysis of firms subject to rapid deterioration in their financial condition showed that their net working capital had fallen by an average of 66 percent in two years, or an average of 33 percent per year. A factor of three was therefore considered adequate to guard against such rapid decreases in tangible net worth and net working capital. The factor of 2 (to ensure current ability to pay) was then multiplied by the factor of 3 (to ensure against a high rate of deterioration before payment can be brought about) to obtain the factor of six chosen by the Agency. In order to ensure more fully that firms will be able to secure needed funds, the Agency further determined that net worth should be required to be tangible net worth. A fuller discussion of the rationale for the multiples requirement is presented in Section II of Appendix A.

4. Analysis of the Costs of Financial Tests

In the course of its study of the performance of financial tests the Agency examined over 300 possible financial tests. From among them it identified a smaller group of tests whose performance dominated the other alternative tests or which were otherwise of particular interest to the Agency. Next, the Agency undertook an evaluation of the costs of these possible financial tests, and a comparison of their costs with the costs of other forms of financial assurance.

The tests chosen for analysis included the May 19, 1980 proposed financial test; a test labeled "Ability to Pay" which required only $10 million in net worth and both net worth and net working capital greater than six times closure and post-closure costs; a "No Financial Test" option whose costs were based on the assumption that all firms will use a letter of credit; and all of the ratio tests determined to be "best tests." Some of these tests had an eligibility period of one year; others required firms to meet the requirements of a test for three consecutive years before they would be eligible to use the test as an assurance of financial responsibility. The costs of various tests for closure and post-closure were measured for those firms which would be eligible to use a test with a $10 million in net worth and an independent audit requirement. The Agency assumed, for this purpose, that 50 percent of all owners or operators of hazardous waste management facilities would have over $10 million in net worth and that 34 percent of those firms would be independently audited. In addition, supplementary studies were conducted relaxing certain of those assumptions.

Because of certain assumptions adopted for the cost analysis which do not affect the choice of a financial test but which would become critical if the methodology for the cost analysis were to be applied for other purposes, the analysis presented in Appendix B cannot be used as a basis for a cost analysis of the financial responsibility requirements as a whole.

a. Types of Costs Analyzed

Two types of costs were examined by the Agency: direct public costs and private costs.

(1) Direct public costs were defined as those costs of closure and post-closure that must be borne by someone other than the owner or operator of a hazardous waste TSDF. Direct public costs thus represent a quantification of the threat to human health and the environment posed by unfunded financial needs. The costs measured represent the sum of costs which ultimately must be borne by the public for conducting closure and post-closure. Thus, if the funds available from a financial mechanism at the time of need were inadequate, but other funds could be recovered from an owner or operator through legal proceedings, the Agency did not count such recovered funds as part of the direct public

costs. Any costs of litigation associated with the recovery of funds from bankrupt firms were not included in direct public costs. Costs that did not differ with respect to the choice of financial mechanisms, such as the costs to the Agency of administering the regulation and processing reports were also not included, because they are costs that all financial mechanisms have in common.

Within the broad category of direct public costs associated with closure and post-closure financial responsibility, the Agency distinguished two subtypes:

(i) Direct public costs due to bankruptcy of firms using a letter of credit. (For an explanation of why the letter of credit was used, see the following text.) These are all the costs of closure and post-closure that cannot be adequately funded from the letter of credit or from any other funds recovered from the firm.

(ii) Direct public costs due to the bankruptcy of firms using a financial test. These are all the costs of closure and post-closure that cannot be recovered through legal action from firms that go bankrupt after passing the financial test but without providing another mechanism of financial assurance prior to going bankrupt.

(2) Private costs were defined by the Agency as the costs to the regulated community of obtaining financial mechanisms to serve as assurances of financial responsibility, e.g., fees for letters of credit, fees for surety bonds, and costs of financial reports. Because the function of the cost analysis was to compare the costs of the financial mechanisms used to satisfy the closure and post-closure requirements,

only the differential costs of mechanisms were measured. Costs that all financial mechanisms have in common, such as the costs to the owner or operator of preparing and revising cost estimates, time spent on choosing a financial mechanism, and routine management costs associated with maintaining any financial mechanism were not included in private costs.

For the analysis of financial tests providing financial assurance for closure and post-closure care, two types of private costs were considered:

(i) The private costs of letters of credit. These costs include the fees for the letters of credit. They do not include the fees for the accompanying standby trust funds; these fees, however, will in most cases be minimal. The effect of a letter of credit on future borrowing costs is not included as a cost of a letter of credit, because it would be extremely difficult to distinguish this effect from the more general effect of having a certain future obligation (i.e., an obligation to perform closure or post-closure care) for which the letter of credit only provides a type of third-party guarantee. Borrowing costs for all owners or operators may be affected by closure and post-closure financial assurance obligations whichever financial assurance mechanism is provided, albeit to different extents.

The letter of credit was chosen as the instrument whose costs in the absence of a financial test would be analyzed in comparison to the costs of a financial test because it would be the instrument most likely to be used by independently audited firms of greater than $10 million in net worth, and because it will probably be the least expensive instrument. Both the letter of credit and the surety bond will be less expensive than the trust fund. However, the letter of credit will be more readily available, particularly to firms that can supply collateral or which have established credit, and will probably be slightly less expensive than the surety bond. The costs of the closure insurance mechanism will probably fall between those of the letter of credit and those of the trust fund.

(ii) The private costs of a financial test. These costs include the annual preparation of auditors' special reports. The Agency requires that these firms be independently audited and that the special reports be based on annual independently audited financial reports.

b. Overview of the Cost Model

The structure of the model used by the Agency to examine the direct public costs and private costs of financial tests for closure and post-closure financial assurance is shown in Figure 3. A fuller description of the model and the assumptions are included in Appendix B to this document. The cost analysis was carried out first for independently audited firms of more than $10 million in net worth and then for all independently audited firms, including those with less than $10 million in net worth. (No costs are included for firms which would not be eligible for the test because they are not independently audited.) The Agency estimated that about 34 percent of those firms over $10 million in net worth are independently audited and approximately 2.7 percent of those firms under $10 million are independently audited. The results reported in the Background Document are for all independently audited

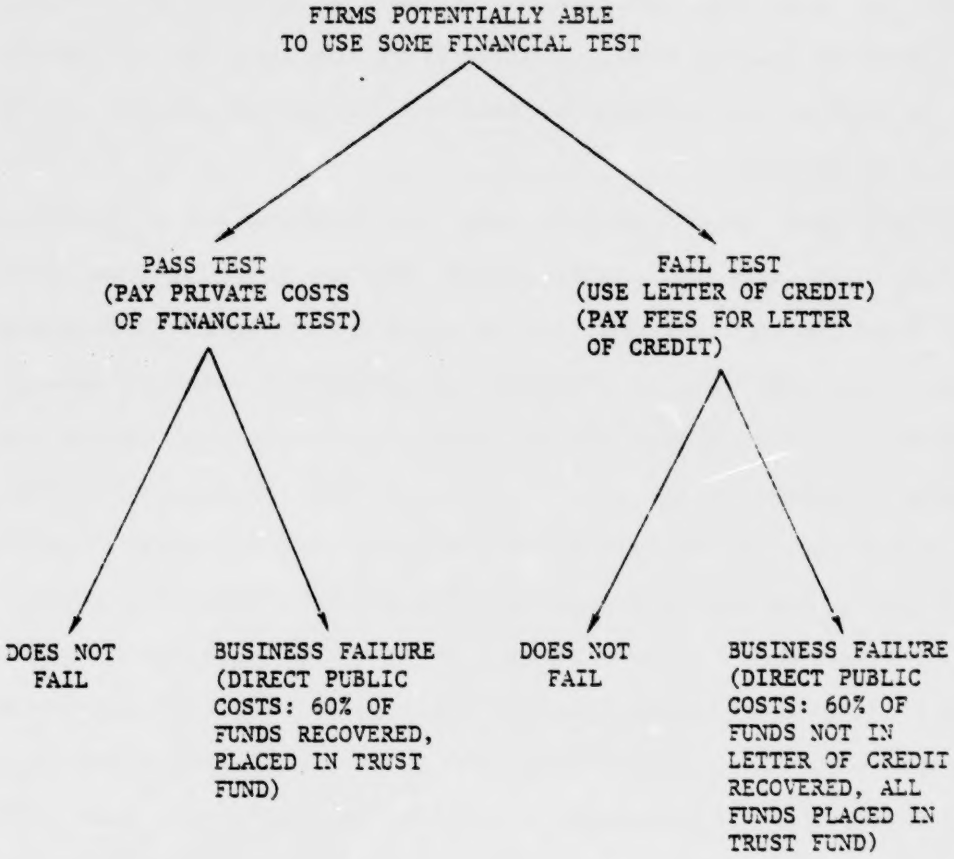

FIRMS POTENTIALLY ABLE TO USE SOME FINANCIAL TEST
PASS TEST (PAY PRIVATE COSTS OF FINANCIAL TEST)
FAIL TEST (USE LETTER OF CREDIT) (PAY FEES FOR LETTER OF CREDIT)
DOES NOT FAIL
BUSINESS FAILURE (DIRECT PUBLIC COSTS: 60% OF FUNDS RECOVERED, PLACED IN TRUST FUND)
DOES NOT FAIL
BUSINESS FAILURE (DIRECT PUBLIC COSTS: 60% OF FUNDS NOT IN LETTER OF CREDIT RECOVERED, ALL FUNDS PLACED IN TRUST FUND)

FIGURE 3

STRUCTURE OF THE COST MODEL

SOURCE: Appendix B, Figure I-1.

firms of more than $10 million in net worth. Costs for all independently audited firms, including firms with less than $10 million in net worth, are included in Section IV.C. of Appendix B to the Background Document.

The Agency assumed in this model the following set of potential events. All firms will either pass or fail any given financial test. All firms that pass the test will incur the private cost of a financial test, i.e., the cost of obtaining an independent auditor's special report. If a firm passing the test does not enter bankruptcy during the period it passes the financial test, there are no direct public costs. If a firm passing the test enters bankruptcy without establishing an alternative financial mechanism, direct public costs are incurred due to a financial test. In determining the amount of these direct public costs, the Agency assumed on the basis of a review of bankruptcy procedure and cases that for firms of more than $10 million in net worth 60 percent of the funds needed for closure and post-closure care could be recovered in a bankruptcy proceeding, and for firms with less than $10 million in net worth only 25 percent would be recovered. It further assumed that the recovered funds would be placed in a trust fund. (See Appendix B, Section III E.)

The Agency assumed that all firms which fail the financial test initially or which establish an alternative financial mechanism prior to bankruptcy would secure a letter of credit to provide financial assurance. The private costs are the fees for the letter of credit. For a firm using a letter of credit, two alternative events may occur.

First, the firm may continue to be a non-bankrupt firm. In that case, no public costs would be incurred. Alternatively, the firm may enter bankruptcy. In that case, direct public costs will be incurred for any costs not covered by the letter of credit which cannot be recovered from the bankrupt firm. Again, the Agency assumed that 60 percent of the closure and post-closure care costs not covered by the letter of credit could ultimately be recovered from bankruptcy, and funds for post-closure would be placed in a standby trust fund.

The Agency computed the total private costs for each financial test by adding the private costs of the financial test for those firms able to pass that test and the fees associated with the letter of credit for those firms unable to pass the test. The direct public costs of each test were then computed as the sum of the direct public costs due to use of a financial test for those firms able to pass the test that later enter bankruptcy and the direct public costs due to use of a letter of credit for those firms that fail a financial test and later enter bankruptcy.

c. Costing Conventions

All costs developed in the study are presented as annual costs in 1980 dollars. The annual cost presented should not be confused with expenditures required in any given year, however, because both public and private costs incurred during the post-closure period were computed at their present value and annualized over the life of the facility. Since costs are measured in 1980 dollars, no account was taken of the effect of inflation on the actual required current dollar expenditures in any given year. The post-closure private costs and direct public costs of disposal facilities were annualized over the life of the facility. This means that expenditures that would be required over the entire 30 year post-closure period are presented as annual costs in the year the facility fails, and failures occurring in the post-closure period are annualized back over the life of the facility.

5. Rationale for Standards

a. Financial Test

In reviewing the results of the cost analyses of the various potential financial tests for closure and post-closure, the Agency compared alternative financial test formats to each other and considered financial tests in relation to other mechanisms for financial assurance. The Agency, in this review, paid particular attention to three goals.

(1) Funds should be available for closure and post-closure care to ensure protection of human health and the environment.

(2) As a matter of equity, the parties responsible for closure and post-closure obligations should pay those costs.

(3) Costs to the regulated community should be as low as possible.

The two cost measures developed by the Agency -- direct public costs and private costs -- capture major aspects of the goals set for a financial test. Direct public costs provide a measure of the costs that must be paid by the public to prevent threats to human health and the environment that could be caused by facility deterioration if closure or post-closure care were not performed. Because direct public costs also represent the costs of closure and post-closure care not paid for by the party responsible for the facility, they are an indirect measure of equity. Private costs represent the costs to owners and operators of ensuring that funds will be available.

In examining possible financial tests, the Agency first identified the test which minimizes the sum of direct public and private costs. Such a test provides the lowest sum of all costs to the public because, over the long run, private costs to owners and operators will be passed on to the public through increased costs of goods and services. The Agency concluded that the proper method of determining which test to choose should be to determine whether a test can provide the sum of lowest costs and still meet the Agency's goals. These costs include both costs of unfunded closure and post-closure paid directly by the public and costs to the regulated community ultimately passed on to the public.

Applying the criterion of minimizing the sum of direct public and private costs to those financial tests which it had previously analyzed, the Agency identified a test which was significantly superior to the test proposed in the May 19, 1980 regulations, and to the option of no financial test. The results of the analysis of the costs of alternative financial tests requiring over $10 million in tangible net worth are shown in Table 2. This test, labeled "Test 100" in Table 2, has a one-year eligibility period and consists of the following requirements:

(1) Tangible net worth of at least $10 million; and

(2) Two of the following three ratios: a ratio of total liabilities to net worth less than 2.0; a ratio of the sum of net income, depreciation, depletion, and amortization to total liabilities greater than 0.1; and a ratio of current assets to current liabilities greater than 1.5.

TABLE 2

PERFORMANCE AND DIRECT PUBLIC AND PRIVATE COSTS OF ALTERNATIVE FINANCIAL TESTS FOR CLOSURE AND POST-CLOSURE*

(in thousands of 1980 dollars per year)

Test Description	Eligibility Requirement (one year or three year)	E_P	A_{NB}	Direct Public Costs Due to Failure of Firms Using a Financial Test	Direct Public Costs Due to Failure of Firms Using a Letter of Credit	Total Direct Public Costs	Private Costs of a Financial Test	Private Costs of a Letter of Credit	Total Private Costs	Sum of Direct Public and Private Costs
No Financial Test	NA	NA	0	0	142	142	0	3,334	3,334	3,476
139	1	0	49	0	142	142	123	1,701	1,824	1,966
125	3	1.4	56	19	137	156	141	1,467	1,608	1,764
138	3	5.4	82	31	134	165	168	1,100	1,268	1,433
127	3	1.9	67	24	136	160	161	1,201	1,362	1,522
138	1	2.8	76	51	129	180	191	800	991	1,171
151	1	3.7	77	68	124	192	193	767	960	1,152
134	1	4.6	79	87	119	206	199	700	899	1,105
136	3	5.4	82	106	114	220	206	600	806	1,026
135	1	5.6	83	112	112	224	208	567	775	999
149	1	6.0	87	125	109	234	219	434	653	887
136	1	7.9	89	169	97	266	224	367	591	857
137	1	9.1	92	201	88	289	231	267	498	787
98	1	9.3	93	207	86	293	234	233	467	760
146	1	9.5	95	225	82	307	239	167	406	713
100	1	10.1	96	234	80	314	241	133	374	688
Ability to Pay Test	3	18.4	99	439	24	463	249	33	282	745
Ability to Pay Test	1	20.2	100	484	12	496	251	0	251	747
May 19, 1980 Test	1 1/	15.7	90	366	44	401	244	100	344	745

1/ The May 19, 1980 proposed test had a one-year eligibility requirement.

SOURCE: Appendix A, Table V-3; Appendix B, Table IV-1.

---

*The assumptions used in this analysis differ somewhat from those used in the preliminary Regulatory Impact Analysis. Probably the most important differences are that the cost estimates for closure and post-closure costs are somewhat higher in this analysis than those used in the preliminary Regulatory Impact Analysis. However, these differences in assumption do not affect the choice of the test which minimizes the sum of public and private costs. See Section IV. B of Appendix B.

The Agency estimated that adoption of Test 100 (1 year) could result in direct public costs of $314,000 a year due to the bankruptcy, with associated unrecovered costs for unfunded closure and post-closure care, of firms using this financial test. The incremental public cost over not adopting any financial test would be $2,788,000. However, this test had the lowest combined public and private cost ($688,000) of any test studied. The combined public and private cost would be $7288 lower than the cost if the test were not adopted. Only about 10.1 firms out of every 10,000 firms that pass this test could be expected to go bankrupt without providing alternative financial assurance. Such bankruptcies would affect about 2.5 sites per year. About 96 percent of all non-bankrupt firms would pass this test.

Such results are conservative estimates, because the final formulation of the test adopted by the Agency also includes the following additional three requirements, whose effects were not part of the analysis, but which clearly make the test more stringent:

(1) Net working capital and tangible net worth each at least six times the sum of the current closure and post-closure cost estimates;

(2) Assets in the United States amounting to at least 90 percent of total assets or at least six times the sum of the current closure and post-closure cost estimates; and

(3) Submission of an independent auditor's opinion of the firm's financial statements and footnotes, which must be unqualified in order for use of the financial test to be allowed without further review. Adverse opinions, disclaimers of opinion, and opinions which raise "going concern" questions will disqualify a firm from using the financial test. Firms which receive other types of qualified opinions will be evaluated on a case by case basis.

Tests without the $10 million in tangible net worth requirement lead to even lower sums of public and private costs. The test with the lowest possible sum of public and private costs is Test 100 without the requirement of $10 million in tangible net worth. This test would lead to savings of $878,000 per year over Test 100 with a $10 million in net worth requirement. Those savings would, however, be entirely in private costs, which would decline by $950,000 per year, while direct public costs would rise by at least $72,000 per year. The rise in public costs could be much larger, since the estimate fails to take account of certain special problems of admitting smaller firms to use the financial test. (See Appendix ~~A~~ B, Section IV.C. for a full discussion of the consequences and results of deleting the $10 million in net worth requirement).

Having found the two variants of Test 100 (both with and without a $10 million in net worth requirement) to be of special interest with respect to the minimization of public and private costs, the Agency reviewed those tests and other possible tests in light of the criteria of protecting human health and the environment, equity, and minimizing costs to the regulated community. Table 3 provides further data on Test 100 used in this review.

In respect to protecting human health and the environment, the Agency estimated that if Test 100 were to be adopted, an average of 2.5 facilities per year would enter bankruptcy without providing an alternative financial responsibility mechanism. This is a small number of facilities and means probably could be found of providing funds for the

TABLE 9

CHARACTERISTICS OF FIRMS THAT PASS SUCCESSIVELY LESS STRINGENT TESTS

	Firms That Pass Test 100 (One-Year) With a $10 Million Net Worth Requirement	Firms That Pass Test 100 (One-Year) Without a $10 Million Net Worth Requirement That Would Not Pass Test 100 With a $10 Million Net Worth Requirement	Firms That Pass an Ability to Pay Test (One-Year) Without a $10 Million Net Worth Requirement That Would Not Pass Test 100 Without a $10 Million Net Worth Requirement
Number of facilities affected	2,448	194	110
Number of firms per 10,000 per year that pass the test and will go bankrupt without providing alternative financial assurance	10.1	28.5	285
Number of facilities failing per year[1/]	2.5	.6	3.1
Number of bankruptcy proceedings per year[2/]	.6	.6	1.2
Percentage of closure and post-closure costs not recovered in bankruptcy proceedings	40%	75%	46%

[1/] The number of facilities failing per year is derived by applying the failure rate listed above for the given test to the number of facilities affected.

[2/] The number of bankruptcy proceedings is based on the assumption that firms of greater than $10 million in net worth own an average of four facilities and firms of less than $10 million in net worth own an average of one.

Reproduced from best available copy.

closure and post-closure of such facilities. For the near future, Superfund will also be available as a supplementary source fo funds to pay some of the costs not paid by owners or operators. To ensure, by not allowing a financial test, that no facilities would fail without providing alternative financial mechanisms would lead to an additional $3.3 million in private costs per year. That is, private costs of $1.1 million per facility failure would be required to ensure than an alternative financial mechanism would be available in all cases. The Agency considers this an excessive cost for the small additional assurance provided.

The analysis of numbers of failures shown in Table 3 is based upon the assumption that firms of under $10 million in net worth which would use the test are relatively typical of all independently audited firms of under $10 million in net worth. However, the hazardous waste regulatory program will introduce requirements that may add to the expense of treating, storing, or disposing of hazardous waste. The Agency is concerned that the future business failure rate for firms with less than $10 million in tangible net worth which treat, store, or dispose of hazardous waste and the number of such facilities which close because of noncompliance with the regulations could be higher than the historical rate for small firms in general.

The Agency also was concerned that if an owner or operator purposely sought to circumvent these and other regulations (i.e., Subpart G, Closure and Post-Closure care) by abandoning his facility without having provided for its closure or post-closure care, he might do so by setting up a firm which was just able to meet the multiple and ratio requirements of a financial test. The $10 million in tangible net worth requirement should make it less likely that an owner or operator would find it possible or even profitable to plan to avoid responsibilities by satisfying the financial test. There will be fewer cases where the facility itself represents the only significant asset of the owner or operator. Monitoring the use of the financial test would be made more difficult if its use were not limited to the larger more stable firms. Small firms that obtain an independent audit solely for the purpose of satisfying the financial test would be difficult to monitor because these audits would not be subject to SEC review. Furthermore, the number of situations in which failure to close a facility might cause unusual threats to human health and the environment should be reduced.

Because an estimated 99.9 percent of the firms that pass Test 100 in any given year will not enter bankruptcy without providing alternative financial assurance, the Agency's equity goal would also be satisfied. The Agency estimates that on the average 60 percent of funds will be recovered from those firms that do not enter bankruptcy without an alternative financial mechanism. (For firms with under $10 million in net worth, the Agency estimates that this recovery percentage would fall to 25 percent.) For a facility with a facility-life of 20 years and a post-closure care period of 30 years, 98 percent of facilities passing the financial test will be able to meet closure costs or provide alternative financial assurance without entering bankruptcy, and 95 percent will provide all closure and post-closure care expenditures or alternative financial assurance without entering bankruptcy. As noted above, if 100% of the firms eligible for this financial test had to use the alternate financial mechanisms allowed by the regulation, this would cost them $3 million a year. Thus, the equity goal of the regulation has been substantially achieved, and to achieve it more perfectly would entail very substantial costs.

Given the very high percentage of firms that are ultimately able to pay all costs associated with closure and post-closure, the Agency considered whether it would be reasonable to choose a somewhat less stringent test, such as the tests labeled "Ability to Pay Test" in Table 2. Such tests could require either a one year or a three year eligibility period. They both require net working capital and tangible net worth six times the sume of closure and post-closure cost estimates, but do not include any ratio requirements. Use of a one year Ability to Pay test would allow approximately 110 additional firms to use the financial test to provide assurance of financial responsibility. However, use of the Ability to Pay Test would also double the number of situations in which a firm passing the financial test would go bankrupt without providing alternative financial assurance, and would at least double the number of bankruptcy proceedings the Agency would participate in each year. The 110 firms that pass the Ability to Pay Test but fail to pass Test 100 have an annual failure rate of 2.85 percent per year.

The Agency's analysis indicated that only 56 percent of such firms passing the test would be able to either meet closure costs or provide alternative financial assurance without entering bankruptcy over the 20-year period of facility life during which closure could be required. Finally, the Agency estimated that only 26 percent could last the entire 50-year period of facility-life (20 years) plus post-closure care (30 years) and the Agency found this possibility to be unacceptable from an equity viewpoint.

In respect to minimization of private costs, the Agency found that Test 100 with a $10 million in net worth requirement has the lowest sum of public and private costs of any test with a $10 million in net worth requirement. An Ability to Pay Test with a $10 million in net worth requirement and several tests without a $10 million in net worth requirement have lower private costs. Test 100 without a $10 million in net worth requirement has the lowest sum of public and private costs, although, as will be discussed in the limits to the analysis section immediately below, under possible but relatively unlikely alternative assumptions the Ability to Pay Test could emerge as the test that minimizes the sum of public and private costs.

Taking into consideration all of its goals, including protection of human health and the environment and equity, however, the Agency considers Test 100 with a $10 million in net worth requirement to be the best of the available tests and has adopted it for purposes of the financial assurance regulations. In so doing, the Agency noted that the lower private costs associated with firms of under $10 million in net worth using a financial test would be negated by the need for the Agency to spend public funds for review of audits not otherwise reviewed by the SEC. The possibility that the Agency would find it necessary to review audits is relatively unlikely for firms of greater than $10 million in net worth because the cost of an audit for such firms would normally exceed the cost of alternative financial instruments and these firms therefore would have little inducement to obtain questionable audits in order to avoid other costs.

As an alternative for utilities and other firms that are financially strong but cannot pass Test 100 due to special financial circumstances (although almost 70 percent of all utilities could pass Test 100), the Agency has decided to adopt the suggestions of a number of commenters and use bond ratings, coupled with a tangible net worth requirement, as a substitute criterion in the financial test. Analysis of available data on the performance of the two major bond rating services showed that firms receiving any of their four highest ratings (investment grade bonds) have compiled a record of financial assurance at least equal to that of Test 100. The Agency noted that no firm with an investment grade bond rating was among the sample of bankrupt firms it had collected. In order to ensure that adequate assets are available to cover possible closure and post-closure expenditures, a firm using the bond ratings test is also required to have a tangible net worth of at least $10 million and six times the closure and post-closure cost estimates to be covered. To ensure accessibility of funds, the firm is required to have 90 percent of its assets in the United States, or to have assets in the United States six times the amount of the cost estimates. Bond ratings must be for the most recent bond issue of the owner or operator. The Agency initially will accept only bond ratings issued by Moody's or Standard and Poor's.

b. Limits to the Analysis

An analysis of the type used to develop the results in Table 2 must incorporate uncertainties and approximations. Many assumptions had to be made about financial mechanisms which have never been used before in exactly the same form, and about the technical and financial characteristics of the hazardous waste management facilities which will be affected by this regulation.

The degree of accuracy of those assumptions could affect the conclusion about which test best satisfies the Agency's criteria. The Agency therefore conducted a sensitivity analysis to determine which changes in assumptions were most likely to affect results significantly. This sensitivity analysis, described in Appendix B, indicates that even with a wide variety of changes in assumptions, Test 100 (one-year) minimizes the sum of direct public and private costs for firms with over $10 million in net worth. The most important limitations on this conclusion are described below.

If a significant percentage of firms failing Test 100 (one-year) had to use a trust fund as the alternative financial mechanism, the test termed "Ability to Pay Test" in Table 2 would have a lower sum of direct public and private costs. Given the uncertainties about the number of firms that would be forced to use a trust fund if unable to pass a financial test, however, the Agency did not incorporate these costs in the comparison of Test 100 (one-year) with other less stringent tests. The Agency calculated the effects of shifting from Test 100 to the less stringent Ability to Pay Test (see Table 3) to see if this assumption could have a significant effect on the choice of test. Use of the Ability to Pay Test would allow approximately 110 additional firms to use the financial test to provide assurance of financial responsibility. However, use of the Ability to Pay Test would also double the number of situations in which a firm passing the financial test would go bankrupt without providing alternative financial assurance, and would at a minimum double the number of bankruptcy proceedings the Agency would have to participate in per year. The additional failures would considerably increase the risks to human health and the environment, the alleviation of which would add $182,000 to public costs, in return for a savings of only $123,000 for the additional 110 firms enabled to pass the less stringent Ability to Pay Test. Even if some of these firms were forced to use the more expensive trust fund if Test 100 (one-year) were the chosen test, the Agency concluded that the potential threats, inherent in the use of the Ability to Pay Test, to human health and the environment make Test 100 (one-year) preferable.

The determination of the test which minimizes the sum of direct public and private costs is highly sensitive to the percentage of viable firms passing the test. This percentage cannot be calculated with a high degree of accuracy without better data than are now available on the financial characteristics of owners and operators. The percentage of viable firms shown as passing a test in Table 2 are based upon a sample made up of firms of various sizes in those industries believed to be likely to own or operate TSDFs. Unfortunately, data concerning who would apply for permits were not available at the time this analysis was developed. As a result, the actual owners or operators of hazardous waste TSDFs could have a different distribution of financial characteristics than firms that the sample employed.

Without detailed data on the distribution of net worth and net working capital of owners or operators and the closure and post-closure cost estimates for each owner or operator, it is impossible to determine the effect of the multiple requirements upon either E or A_{NB}. The results in Table 2 were derived by assuming that firms that could meet a set of ratio requirements and had positive net worth and net working capital would be able to use a financial test. As a result of this assumption, the values of E and A_{NB} are overestimated. The levels of the multiple requirements for tangible net worth and net working capital were based upon an analysis showing that these levels would provide reasonable financial assurance rather than upon an analysis of their effects upon E and A_{NB}.

Other limitations to the analysis were considered unlikely to affect the results with respect to which test minimizes the sum of direct public and private costs. They could, however, significantly alter the values of the costs shown in Table 2. The number of firms independently audited and thus potentially eligible to use the financial test is highly uncertain. The sensitivity analysis presented in

Appendix B showed that this uncertainty did not affect the result that Test 100 (one-year) is the test which minimizes the sum of direct public and private costs. The accuracy of this assumption could significantly alter the costs associated with the financial responsibility regulations as a whole and the cost saving associated with allowing a financial test.

Because the number of independently audited firms is highly uncertain, the Agency was also unable to predict the number of subsidiaries of independently audited firms that would be eligible for the corporate guarantee provision.

A variety of other assumptions, particularly with respect to the costs of closure and post-closure care, the baseline failure rate, and the fees for various financial instruments, are highly uncertain, but the range of uncertainty is not such as to alter the result as to which financial test minimizes the sum of direct public and private costs.

The estimate of direct public costs due to failure of firms using a financial test assumes that there is no growth in costs due to the absence of funds to provide adequate preventive care. It is possible that if no funds were available to take preventive measures, damages caused by delayed or insufficient closure of a facility could result in higher closure and post-closure costs than would have been incurred if funds had been available. This increase in costs could be prevented only if there existed a national fund from which money could be appropriated to prevent such occurrences. Avoiding such cost growth due to the absence of funds is a major benefit of financial mechanisms (other than a financial test) which is not accounted for in this analysis. However, the sensitivity analysis in Appendix B shows that this factor could be quite substantial and still not alter the result that allowing a financial test has a lower sum of direct public and private costs than not allowing a financial test.

The analysis does not consider certain potential economic benefits associated with financial responsibility requirements. To the extent that financial responsibility requirements result in owners or operators of TSDFs internalizing cost externalities, the price of hazardous waste management will more accurately reflect its true costs. This higher price will lead to less use of hazardous waste TSDFs. Further, if owners or operators are assured that they will ultimately pay for the costs of closure and post-closure care, they will take special care to avoid events that could lead to high closure and post-closure care costs. As a result, the regulation may produce economic benefits resulting from more efficient resource allocation.

One effect of the above limitations is that the analysis presented in Appendix B cannot be used as a basis for a cost analysis of the financial responsibility requirements as a whole. Certain assumptions, which do not affect the choice of a financial test, would become critical if the methodology for cost analysis employed in Appendix B were to be employed to analyze the financial responsibility requirements as a whole.

c. Corporate Guarantee

The Agency did not carry out a cost analysis of the corporate guarantee provision. It is convinced, however, that the corporate guarantee will enable large, financially secure parent firms to assume responsibility for the hazardous waste management facilities owned or operated by their subsidiaries when the parent firms might otherwise be unwilling or unable to do so, and will therefore add to the assurance of financial responsibility provided by the regulations. After a careful review of the terms of the guarantee proposed on May 19, 1980, the Agency added several provisions designed to make the instrument more flexible and to help ensure that it can be enforced easily. It included a waiver of notice of acceptance, an express agreement on the part of the guarantor to remain bound notwithstanding modifications in the closure or post-closure plan or certain other modifications or alterations, and an agreement that the guarantor will perform closure or post-closure care or fund a trust fund in the amount of the current closure or post-closure estimates.

The Agency decided to limit use of the guarantee to parent corporations, defined as firms owning at least 50 percent of the voting stock of the subsidiary which is the owner or operator of the hazardous waste facility. At least 50 percent ownership was adopted as a requirement in order to ensure that the connection between the two firms is close and direct. The capacity of the guarantor to enter into the guarantee is more certain if it is directly promoting its own business purposes by means of a guarantee for a corporate subsidiary. Furthermore, the parent company is likely to have a strong interest in the satisfactory performance of its subsidiary, both in financial terms and in respect to the subsidiary's performance of its legal obligations, and, in the Agency's view, this incentive strengthens the corporate guarantee.

The Agency also decided to refer to the guarantee as a corporate guarantee to clearly differentiate it in the regulations from the financial guarantee by sureties and from guarantees by States.

d. Revenue Test for Municipalities

In determining the applicability of the financial responsibility standards established under Section 3004(6) of RCRA, the Agency concluded that the regulations should apply to local government owners or operators of hazardous waste facilities. Because States and the federal government have proven longevity and the capacity to raise significant financial resources, the Agency decided that those government entities will always have adequate resources to conduct closure and post-closure care activities properly. Consequently, in a financial responsibility final regulation issued on May 19, 1980, the Agency provided that the fact that a facility was owned or operated by a State or the federal government was sufficient to establish assurance of financial responsibility (45 FR 33262, 33198-99).

The Agency was aware that local governments share with States and the federal government characteristics which distinguish them from private owners or operators. They have access to unique sources of revenue not available to private entities. They are institutions of indefinite longevity, which do not fail or go out of existence in the same ways that private businesses do. Finally, local governments are organized to secure the well-being of their citizens, and may be expected to seek conscientiously to carry out their obligations which affect public health and the environment.

The Agency was also aware, however that unless "municipality" -- the category of local government used in RCRA to encompass all government entities except States or the federal government -- is defined properly, entities that do not share the characteristics of longevity, financial strength, and responsibility toward human health and the environment could be included in it. Furthermore, the record of municipalities in avoiding bankruptcies and defaults is not as good as the record of the States. Some municipalities might be too small to have sufficient financial resources to fulfill their closure and post-closure obligations. Finally, the options of readjusting expenditures or raising revenues might be legally, practically or politically impossible for some local governments. The May 19, 1980 reproposed regulations (45 FR 33268, 33273) therefore provided that if the owner or operator of a hazardous waste facility were a municipality it would have the option of providing an assurance of its financial responsibility for closure and for post-closure care by giving evidence of having annual revenues from property, sales and/or income taxes equal to 10 times the adjusted closure and/or post-closure cost estimates. Such tax revenues had to be legally available. That is, they could not be dedicated to other purposes or otherwise precluded from use. The Agency reasoned that a municipality with such tax revenues could if necessary shift or curtail its expenditures so that money for closure and post-closure care would be available. If the annual tax revenues at any time failed to meet the minimum multiple or became legally unavailable, the municipality would be required immediately to secure another form of financial assurance, such as a trust fund, letter of credit, or surety bond. Alternatively, if a State were to assume legal responsibility for compliance with closure or post-closure requirements, the local government would not be required to provide another form of financial assurance (45 FR 33273).

In response to comments received on the reproposed regulations of May 19, 1980, the Agency reanalyzed the subject of municipal financial responsibility for closure and post-closure care.

First, the Agency considered the argument that facilities owned or operated by municipalities should be given the same treatment as that accorded to State or federally owned or operated facilities. A few commenters suggested that municipalities may include large cities or public authorities, with sizable populations and financial resources, which are operated according to sound financial principles. The record for such entities of avoiding defaults is quite good, and they eventually have repaid their obligations even on those occasions when they technically defaulted. Like other government entities, they are the subject of strong public pressures to conform to laws protecting human health and the environment. On balance, however, the Agency concluded that there is a reasonable basis for according different treatment to State and federally owned or operated facilities from that accorded to those owned or operated by municipalities. Such local entities are not legally autonomous bodies, but are instead creations of the States. Thus they are subject to restrictions on the type and extent of the financing they may employ, and they may be required unexpectedly and involuntarily to make additional expenditures. Among them there will be many smaller entities, with fewer resources at their ultimate disposal. As noted above, municipalities as a whole have a history of a greater number of defaults than States or the federal government. It generally takes them some time to pay their obligations after default, and ensuring that facilities are closed in a timely manner is an important purpose of the financial responsibility requirements. Finally, because they are smaller, they may be more likely to be influenced by the needs of a single large industry or plant to keep the level of taxation low, even at the cost of unmet needs, or to be the focus of so-called tax revolts.

Second, the Agency examined the budgeting and accounting practices of municipalities to determine whether there are particular methods by which they could dedicate portions of their funds to closure and post-closure care. It also reconsidered its assumption that a municipality can shift funds already received and budgeted to specified purposes away from those purposes to the task of providing closure and post-closure care. Finally it considered whether a mechanism similar to a financial test could be developed by which the Agency could determine the ability to pay closure and post-closure costs of a municipality. The Agency determined that there are limits on municipalities ability both to dedicate funds and to shift, reallocate, rebudget, or cut back funds, and that a test for municipalities' based on detailed financial information was not currently feasible due to variations in accounting procedures.

The Agency has determined that in practice municipal budgeting, expenditures, and accounting procedures vary greatly and respond to many different factors. (See, e.g., Break, Financing Government in a Federal System, 187 ff., (1980); Levine, ed., Managing Fiscal Stress: The Crisis in the Public Sector (1980)) The budgetary categories and limits of local governments are ordinarily set through the political process and through a process of planning and priority setting. Ideally this procedure is accompanied by long-term revenue and expenditure forecasts, and by an accounting system which allocates the revenues of the government to funds set up to preserve the resources necessary to accomplish the planned objectives. Because of shifting political and policy priorities and chronic immediate needs for funds, however, it appears that in practice, in the absence of legal provisions requiring money to be set aside, the funds for closure and post-closure care probably would not be placed in a specially isolated fund, but would be reallocated from the general funds of most jurisdictions at the time they are required. The Agency has concluded that it is not feasible at this time for it to specify and enforce accounting practices for municipalities that will require them to set up special accounts for closure and post-closure funds.

On the question of budget reallocations and cutbacks, the Agency has concluded that although in emergencies municipalities might be able to reduce budgeted expenditures in some areas to shift the funds to closure and post-closure care, there is no strong evidence that such shifts could occur. Net reductions in total city spending have been documented for a few cities faced by financial crises. A study conducted by the Advisory Commission on Intergovernmental Relations of city financial emergencies notes that in the early 1970's two cities were able to make reductions in their expenditures of 10 and 14 percent of the previous year's expenditures. The study concluded, however, that the cases examined "did not answer the question of how far services can be reduced or taxes increased without serious consequences to cities in financial trouble." (ACIR, City Financial Emergencies: The Intergovernmental Dimension, 48 (1973)) More recently, New York City was able to carry out a 20.8 percent attrition of its work force (Glassberg, "Organizational Responses to Municipal Budget Decreases," Public Admin. Rev. 327 (1978)) This reduction, however, was conducted in extremely unique circumstances. Kent, Ohio recently closed a budget gap of almost 20 percent using innovative computer techniques to revise allocations. (U.S. Dept. of H.U.D., Local Financial Management in the 1980's: Techniques for Responding to the New Fiscal Realities, at 61-67 (1980)) A study of 30 major cities for the period from 1975 to 1977 apparently concluded that "most governments were capable of readjusting their expenditures to balance with reduced revenue growth ...." Of the 15 cities with deficits, however, only six had imbalances greater than five percent of expenditures. (Dearborn, "Elements of Municipal Financial Analysis: Part II: Budget Performance," Special Report, First Boston Corp., 1977, cited in Petersen, "Simplification and Standardization of State and Local Government Fiscal Indicators," XXX Nat. Tax. J. 304 (1979)

Aside from these isolated case studies interpreting data from the early and middle 1970's, the Agency has not been able to find or to generate strong empirical support for the possibility of a 5 to 10 percent reallocation of municipal expenditures in one year, especially under current economic and fiscal conditions. Most analyses do not provide broad data on past cutbacks, but instead concentrate on the politics and management of cut back situations. (See White, "Government Response to Spending Limitations," XXX National Tax Journal, Supplement, 201 (June 1979); Hale and Douglass, "The Politics of Budget Execution: Financial Manipulation in State and Local Government," 9 Administration and Society, 367 (Nov. 1977); Levine, "Organizational Decline and Cutback Management," Public Admin. Rev. 316-25, (1978); "More on Cutback Management: Hard Questions for Hard Times," Public Admin. Rev. 179-183 (1979), and Glassberg, "Organizational Responses to Municipal Budget Decreases," Public Admin. Rev. 327 (1978)). The Agency does not believe that the public finance literature provides adequate support for the proposed revenue test.

Most commenters on the proposed revenue test have suggested to the EPA that they do not believe that shifts in expenditures are possible, up to the level of 10 percent suggested in the May 19 proposed regulation, without severely affecting other essential public services. Several challenged the assumption in the May 19 proposal that expenditure shifts up to 10 percent of tax revenues could be made speedily and without disruption by local governments. Some did suggest that shifts on the order of 5 percent of tax revenues were more likely to be possible without serious local hardship. Several commenters argued that even if expenditure shifts were possible, the Agency could not feel certain that they always would be acceptable. On balance, therefore, the Agency concluded that the public comments did not support the proposed revenue test.

The Agency also considered the use of a test for municipalities based on detailed financial information indicative of current financial solvency. Because accounting and reporting procedures of minicipalities in general vary greatly, however, the Agency concluded that a requirement which would be based upon the quantification of assets and tangible net worth would not be uniformly applicable or would impose a heavy administrative burden on the Agency to verify. The Agency does not believe that municipal bond ratings, a criterion suggested by several commenters, would be adequate as a sole indicator of ability to pay the amounts of the estimated closure or post-closure costs. The Agency was thus unable to develop a set of financial indicators, similar to the financial test criteria, that would be suitable for municipalities in general. A number of special-purpose, fee-based municipalities are essentially identical to private entities; because of their financial characteristics and accounting and reporting practices.

they may be able to use the financial test to satisfy the financial assurance requirements.

In its analysis the Agency investigated the possibility that a municipality might obtain additional income with which to carry out closure or post-closure care. It concluded, however, that the traditional sources of income could not always be expanded as needed to provide closure or post-closure care, or that such expansion could not be accomplished quickly enough to provide the necessary degree of financial assurance. Budgetary and legislative processes, bond issues, or voter approval of new taxes could all be sources of delay.

Finally, enforcement proceedings against a municipality to bring about the availability of funds for closure or post-closure care by a municipality may engender difficult issues in federal-state-municipal relations.

For these various reasons the Agency has concluded that it will not include the revenue test as a means of assuring financial responsibility by municipalities.

The Agency believes that municipalities that are financially sound will be able to use one of the other financial assurance mechanisms allowed. These include the State guarantee, which may be an especially appropriate mechanism for municipalities. Municipalities are creatures of State law, and the States are in a far better position to gauge the financial condition of their municipalities than is EPA. Consequently, in the event a State wishes to reduce the cost of the program to its municipalities, it may choose to guarantee the obligations of certain or all of its municipalities. In the event a State lacks sufficient confidence in the fiscal strength of its municipality to extend such a guarantee, it would clearly not be in the interest of the public as a whole for EPA to allow such a municipal entity to avoid these requirements.

B. Criticisms of Test Components Proposed on May 19, 1980

1. Net Worth Requirement

The financial test proposed on May 19, 1980 required that an owner or operator seeking to meet the standards of Part 264 or Part 265 have at least $10 million in net worth.

Comments and Responses

- o The $10 million in net worth requirement is unnecessary.
- o The $10 million in net worth requirement is too high.

The analysis described in Section IV above and in Appendices A and B has convinced the Agency that the proposed $10 million in net worth requirement is necessary in order to achieve the goals described in Section IV.A.5 above. The precise size of the net worth requirement was determined after analysis of data showed that firms in the $10 million in net worth and larger category have sharply lower failure rates than smaller firms. (See Appendix A, Section II)

- o A test component involving absolute size, such as a minimum level of net worth, will help to satisfy the financial responsibility requirement.
- o A test component involving absolute size discriminates against small firms.
- o A net worth requirement should specify tangible net worth to ensure that assets can be quickly converted into cash.

- The value of a hazardous waste management facility should not be included in net worth for purposes of satisfying the $10 million in net worth requirement.

An absolute net worth or an absolute size criterion does enhance the effectiveness of a financial test in predicting bankruptcy and therefore in reducing the level of direct public costs. Such a criterion, however, also substantially increases the private costs of a financial test, since it requires firms falling below the criterion to use other mechanisms. In its analysis the Agency considered the costs of financial tests both with and without a $10 million in net worth requirement. It concluded that it could best achieve its goals by adopting a financial test that contained a $10 million in net worth requirement.

It is correct that a test component requiring a particular level of assets, net worth, or net working capital may make it more difficult for small firms to pass that test. Such a criterion, however, bears a reasonable relationship to the purposes of a financial test. The financial responsibility regulations are designed to assure that funds will be available for closure and post-closure care. Firms with small amounts of resources may face certain inherent limits on their ability to manage treatment, storage and disposal facilities and to provide financial responsibility for hazardous waste management facilities. Although every firm may not be able to use the financial test, the Agency has also provided several other options for assuring financial responsibility.

The Agency agrees that the $10 million in net worth requirement should require tangible net worth. Assets of firms often include significant amounts of intangible assets such as goodwill or patents and trademarks, which may be difficult to convert into cash. Requiring tangible net worth will avoid situations where firms that have passed the test but later enter bankruptcy will be unable to convert intangibles into cash to meet closure and/or post-closure costs.

The Agency has not required the value of the hazardous waste management facility to be subtracted from net worth for purposes of satisfying the $10 million requirement because to do so would raise the private costs of the test significantly. Such values are not ordinarily reported, and therefore a special auditor's evaluation would be required, at considerable cost.

Final Regulation

The Agency has decided to retain the $10 million in net worth requirement proposed on May 19, 1980 as a part of the financial test. It has added the requirement that only tangible net worth may be used for this purpose.

2. Working Capital Requirement

The financial test proposed on May 19, 1980 required that an owner or operator seeking to meet the standards of Part 264 or 265 have net working capital of at least twice the adjusted closure cost estimate, post-closure cost estimate, or sum of closure and post-closure cost estimates.

Comments and Responses

- The requirement that net working capital be a multiple of closure and/or post-closure costs is unfairly restrictive. The Agency should require only that a firm have positive net working capital after closure and/or post-closure costs are subtracted from working capital.

The Agency's analysis, described in Appendix A, of financial data for bankrupt firms indicated that a very large majority of them experienced rapid deterioration of working capital in the years immediately prior to bankruptcy. In addition, the Agency wanted to avoid a situation in which closure and post-closure costs created a negative net working capital position. Particularly for manufacturing firms, negative net working capital may place the firm in a difficult financial situation. The Agency therefore believes that a multiple of net working capital is necessary. A discussion of the rationale for the multiples selected is presented in Section II of Appendix A.

- The net working capital requirement unfairly discriminates against particular industries that are financially secure but do not customarily maintain high levels of working capital.

The Agency sought insofar as possible without significant loss of performance to adopt a financial test which does not unfairly discriminate against any particular industry. It is convinced that a working capital multiple requirement is a necessary part of a financial test provision.

In its analysis, described in Appendix A, the Agency reviewed the working capital practices of several industries. In particular, because it assumed that many hazardous waste facilities would be owned or operated by manufacturing firms, it looked at the working capital of such firms, and determined that they normally maintain positive net working capital.

The analysis did show that many financially strong utilities do not maintain positive net working capital. However, as a general solution to this problem, the Agency also developed a bond-rating test alternative which will be available to utilities and to firms in other industries that do not maintain high levels of working capital but are financially sound.

- The available lines of credit of a firm should be included in its net working capital.
- The liquidation value of the fixed assets of a firm should be included in its net working capital.
- The cash flow of a firm should be included in its net working capital.

The Agency sought to adopt the conventional definitions of terms used in generally accepted accounting practices. Because cash flow generally is not included in net working capital, the Agency does not accept the suggestion that it be included for the purpose of these regulations.

Whenever possible, the Agency also sought to use financial categories that can be independently certified. Because it would be difficult to obtain certification for available lines of credit, and because Certified Public Accountants do not certify the liquidation value of fixed assets, as well as because those terms are not generally included in working capital, the Agency does not accept the suggestion that they be included for purposes of a financial test.

- Firms should be required to have a net worth at least as great as the net working capital requirement.

Although it would be unusual for a firm to have less net worth than net working capital, the situation is possible. Such a firm would be very weak financially. The Agency therefore determined to add a requirement that a firm have tangible net worth at least six times the current closure and post-closure cost estimates.

Final Regulation

The final regulation requires net working capital and tangible net worth each at least six times the sum of the current closure and post-closure cost estimates.

3. Total Liabilities to Net Worth Ratio Requirement

The financial test proposed on May 19, 1980 required that an owner or operator seeking to meet the standards of Part 264 or 265 have a ratio of total liabilities to net worth of not more than three.

Comments and Responses

- A ratio of total liabilities to net worth of not more than three is too permissive.

As a result of its analysis of ratios as components of a financial test, the Agency has changed the required ratio of total liabilities to net worth from not more than three to one, to a more stringent requirement of not more than two to one. This ratio need not be met, however, by an owner or operator who can satisfy the two other ratio requirements in the financial test adopted by the Agency.

- Accrued closure and post-closure costs should not be included in current or total liabilities.

The Agency has concluded that a number of firms will probably show part or all of the estimated costs of closure and post-closure care of their hazardous waste facilities as a liability on their financial statements. The Agency therefore has accepted this suggestion.

Final Regulation

The final regulation requires an owner or operator to satisfy at least two out of three financial ratios. One of the three ratios is a total liabilities to net worth ratio of less than 2.0. Closure and post-closure costs included in liabilities in financial statements may be subtracted from total liabilities in the report from the chief financial officer used to support use of the financial test by a firm.

C. Suggested Alternative Components

In addition to recommending changes in the financial test as it was proposed on May 19, 1980, several commenters, who generally supported the use of a financial test, suggested alternative components for such a test.

1. Other Ratios

Several commenters proposed other financial ratios as better indicators of firm viability than the proposed ratio of total liability to net worth.

Comments and Responses

- The total liabilities to net worth ratio should be replaced by a debt to equity ratio.
- The total liabilities to net worth ratio should be replaced by a total liabilities to cash flow ratio.
- The total liabilities to net worth ratio should be replaced by a total liabilities to net income ratio.
- The total liabilities to net worth ratio should be replaced by debt to total capital ratio.
- Either the so-called "current ratio" of current assets to current liabilities or the so-called "quick ratio" of current assets less inventory to current liabilities should be adopted to evaluate short-term liquidity.

- The ratio of income to return on investment should be used as an indicator of earning power.
- The so-called "debt ratio" of total debt to total assets should be used to evaluate the risk of loss in the event of bankruptcy.
- The so-called "times-interest-earned ratio" of earnings before interest and taxes to interest charges could be modified and used to evaluate the extent to which earnings can decline before a firm is unable to meet its closure or post-closure obligations.

The analysis performed by the Agency and described in Section IV.A. above and in Appendix A included a careful study of the performance of numerous financial ratios. These ratios included those found in the bankruptcy forecasting literature, those suggested in comments, and those proposed by financial experts. The Agency gave particular attention to the ratios that had previously produced significant predictive results, were identified as key parameters, and were readily available from corporate balance sheet data. The Agency did not analyze all possible ratios, including some of those proposed in comments, since the range of possible ratios is very large and its own or previous work had already determined that some ratios were not useful. Previous studies (W.H. Beaver, "Financial Ratios as Predictors of Failure," 5 Journal of Accounting Research, Supplement: Empirical Research in Accounting: Selected Studies, pp. 71-102, 1966; and E. B. Deakin, "Business Failure Prediction: An Empirical Analysis," Financial Crises: Institutions and Markets in a Fragile Environment, E. I. Altman and A. W. Sametz, eds., 1977) have concluded that the financial data included in many relatively complicated ratios can also be found in less complicated ones. The

Agency sought, when possible, to use the simplest available ratios. It concluded that analysis of minor, variant ratios would not be likely to add significantly to the results of the study.

Final Regulation

The final regulation requires an owner or operator to satisfy at least two of the following three financial ratios:

Total liabilities to net worth less than 2.0

Sum of net income, depreciation, depletion, and amortization to total liabilities greater than 0.1

Current assets to current liabilities greater than 1.5.

2. Other Multiples

Several commenters proposed other financial multiples as better indicators of firm viability and ability to pay than the proposed tangible net worth and net working capital multiples.

Comments and Responses

- Add to the existing test components a requirement that a firm have positive net income for at least four consecutive years.

A requirement that test criteria be met for a number of successive years was analyzed by the Agency. Such a requirement, in effect, creates an additional set of financial tests. These tests did not provide significantly greater effectiveness than tests which require criteria to be met for one year. In addition, multi-year tests are likely to add unnecessary private costs, mainly because they preclude financially sound firms which have suffered a short period of earnings decline from providing financial assurance through the use of the financial test. In addition, reporting costs would be slightly higher because data from several years would have to be provided. The Agency therefore decided not to adopt this requirement.

- As an alternative to the net working capital provision, require a statement, based on an analysis of the owner's or operator's financial position, that sufficient assets or cash flow are available for liquidation to provide funds at least equal to two times adjusted closure costs.

The Agency rejected the approach to a financial test advocated by this comment because it would have required reliance on a personal judgment by an analyst. The Agency believes, on the basis of a review of this subject with accountants, that Certified Public Accountants would not be willing make the certified predictions called for by the comment. Even if accountants would make such predictions, they might vary markedly depending on the subjective approach of individual accountants.

Final Regulation

The final regulation requires net working capital and tangible net worth each to be at least six times the current closure and/or post-closure costs.

3. Bond Ratings

Commenters proposed that bond ratings be approved as either a supplement to, or an additional component of, a financial test.

Comments and Responses

- Allow investment grade bond ratings issued by Moody's, Standard and Poor's, or Fitch's to be used as an alternative to the proposed financial test.

The Agency agrees, on the basis of an analysis of the effectiveness of bond ratings, that investment grade bond ratings should be allowed as an alternative criterion of the financial test. It has been able to review the effectiveness of such bond ratings issued by Moody's and Standard and Poor's, and at this time will only allow ratings issued by one or the other of these agencies to be used. However, in order to determine whether there are other bond rating services that could also be used, the Agency is requesting information establishing the performance of their ratings with respect to the performance of the ratings of these two services.

- Allow the use of bond ratings by particular industries as an alternative to the proposed financial test.

The bond rating alternative test developed by the Agency allows the use of bond ratings by all industries.

- Require that the bond rating adhere to a recently issued bond (for instance, within the past three years).

The Agency has required that the bond rating be the current rating for the most recently issued bond. It has not required that the bond be issued within a certain period, such as two to three years, however, because such a limitation would reduce the availability of a bond rating test to smaller firms that only occasionally enter the bond market. Even a bond rating for a bond due in two or three years would represent the financial health of the firm for the next two to three years. It is not the purpose of the financial test to make long-term predictions of financial health. This is why the test must be renewed on an annual basis.

- The rated bond should be an unsecured or general obligation bond.

The data the Agency used to arrive at the conclusion that an investment grade bond provides satisfactory protection included both secured and unsecured bonds. A requirement that only unsecured or general obligation bonds be used would eliminate a high percentage of utilities from using the bond rating variant of the financial test. Since the bond rating alternative is primarily designed for the use of utilities, such a requirement would largely negate its purpose. As a result, the Agency believes that it is necessary to allow the use of any bond issue if the bond rating portion of the test is to serve its primary purpose and that such an approach provides adequate protection.

Final Regulation

The regulation provides that a firm may satisfy the closure and post-closure financial requirements by having a current rating for its most recent bond issuance of AAA, AA, A or BBB as issued by Standard and Poor's or Aaa, Aa, A, or Baa as issued by Moody's; and tangible net worth of at least $10 million and six times the current closure and post-closure costs, and have assets in the United States at least six times the current cost estimates or at least 90 percent of its assets in the United States.

4. Other Suggested Alternatives

Commenters proposed several alternative financial responsibility criteria adopted by other agencies of the Federal government. As noted in Section II.C. above, the Agency reviewed these programs as part of its development of its financial responsibility requirements.

- Adopt the Coast Guard financial responsibility regulation (33 CFR 135.213(a)(2)) as an alternative to the proposed financial test.

The Agency reviewed the proposed alternative financial responsibility program but decided not to follow the suggestion that it be adopted for use for several reasons. First, it is primarily adapted to self-insurance for marine oil pollution liabilities which are likely to involve fewer firms than the hazardous waste financial responsibility requirements. Secondly, EPA has sought to develop a program which insofar as possible uses already existing financial data and reports. The Coast Guard program requires several additional statements to be prepared and certified by a Certified Public Accountant. Third, EPA has sought to avoid a requirement that would involve financial experts in the making of judgments about the sufficiency of available assets to cover costs.

- Adopt the Nuclear Regulatory Commission financial responsibility regulation (10 CFR 140.21) as an alternative to the proposed test.

The NRC program requires "adequate resources to provide the financial protection required," but does not specify in greater detail what will constitute adequate proof of such protection. Because the NRC program deals with relatively few facilities, the Commission can devote special financial expertise to each applicant. Because, in contrast, the program of financial responsibility for hazardous waste management facilities will apply to several thousand owners or operators of TSDFs, the Agency has developed a test that does not rely on such individualized judgments.

The Agency also reviewed final and proposed NRC regulations pertaining to financial responsibility for uranium mill decommissioning and for land disposal of low-level nuclear waste. Many of these mechanisms are similar to mechanisms proposed by the Agency.

- o Adopt the Federal Maritime Commission financial responsibility regulation (46 CFR §542) as an alternative to the proposed test.

The FMC self-insurance program requires both working capital and net worth to be shown up to a specified dollar limit. The Agency, in contrast, has decided to adopt a test which requires a multiple of closure and post-closure costs to be on hand as tangible net worth and net working capital. The FMC also utilizes expert financial analysts to review the financial records of applicant firms. The Agency has concluded that the number of owners or operators who are covered by the financial responsibility requirements renders such review unfeasible.

- o Allow a pledge of business assets similar to that previously used by the Office of Surface Mining (30 CFR §806) as an alternative form of financial assurance.

The Agency studied the possibility of accepting pledges as an alternative form of financial assurance. However, it determined that because of the problems of defining proper assets to be pledged, valuation of those assets, custody of the assets, and sale of the assets, it would not adopt this suggestion. The Office of Surface Mining has also withdrawn this option from its regulatory program.

The Agency further investigated the possibility of adopting a security interest as a financial assurance mechanism. Some of the problems associated with the pledge, and the administrative problems of filing the proper forms to create and maintain a secured interest, caused the Agency to reject this possibility.

- Adopt the SEC 40-60 variable "early-warning" system for identifying firms in financial difficulty.

The Agency concluded that the proposed test would create an unreasonable reporting burden on owners and operators since data would have to be provided on many more financial variables. The Agency has sought the least complicated test possible to secure its goals. It is convinced on the basis of its analysis that the test it has chosen provides adequate warnings of financial difficulty.

Final Regulation

Because the Agency did not find any of the proposed alternative tests satisfactory for its purposes, it has developed the financial test in these regulations.

D. Applicability

The financial test proposed on May 19, 1980 established a single set of requirements for all firms seeking to use the test. Several commenters questioned the use of one test for all industries.

1. Request for Industry-Specific Criteria

One commenter proposed that a broad set of specific tests be developed.

Comments and Responses

- Fifteen to twenty tests should be designed for specific industries, defined by specific SIC codes, to take into account the particular characteristics of their financial practices and requirements.

As described in Section IV above and in Appendix A, the Agency was unable to develop tests for specific industries because of the impossibility of creating a sufficiently large sample of bankrupt firms in several industries to obtain statistically sufficient results. The financial test adopted is generally applicable to almost all industries.

2. Industries Requesting Special Provisions

Several commenters from specific industries proposed that tests be developed for their particular industry.

Comments and Responses

- Utilities should be exempted from the financial responsibility requirements, because their service is required by the public and they will not disappear.
- Rural electric cooperatives are stable and are federally supported.

The Agency does not agree that utilities should be given a generic exemption. Electric utilities or other public utilities do not necessarily exhibit proven longevity, access to sizable resources, and avoidance of bankruptcy. Their assets are not always large. Indeed, an electric utility may consist of a single power generating facility or a facility distributing power to a very small area. Such a facility may not be able to afford an unplanned expenditure for closure or post-closure care of a treatment, storage, or disposal facility.

In the past, electric utilities and other highly regulated industries have experienced bond defaults and other severe financial difficulties. Although a utility may continue to exist and provide customer service following liquidation, there could be delays in obtaining adequate funds for closure and post-closure care and they might not be performed in a timely manner.

Even though rural electric cooperatives have successfully avoided default and receive special Federal government support, it is not clear that every rural electric cooperative could afford the closure and post-closure expenditures that would be required of them. Furthermore, the qualification of a rural electric cooperative for Federal financial support is under the discretion of the Administrator of the Rural Electrification Administration (REA). The Federal loans and loan guarantees mandated by the Rural Electrification Act of 1936 to be made to the rural electric cooperatives are contingent upon the cooperatives' loan application passing legal, engineering, economic, and financial tests developed by the REA.

- o Utilities typically do not hold high net working capital, and therefore, special financial test provisions that do not require net working capital should be developed for their use.

The Agency agrees with this comment in the sense that it has developed a bond rating test for use by all categories of industries, including utilities.

- o The wood preservation industry is composed of many small firms. Special provisions should be created for small firms.

The Agency has found that the $10 million in net worth requirement is a necessary component of a financial test. Use of the financial test will probably therefore be unavailable to members of this industry. However, this is not a special problem of this industry, but of small firms generally. The Agency has concluded that there is a rational basis for limiting the use of financial tests to firms with at least $10 million in net worth. The reasons for this conclusion have been discussed above.

- Airlines frequently do not have positive net working capital even when they are in good financial condition. Special provisions should be created for airlines.

The Agency has provided a bond rating test as an alternative to the financial test. The Agency has also promulgated other mechanisms that owners or operators may use to satisfy the financial responsibility requirement.

3. Proposed Distinction Between On-Site and Off-Site Disposers

Comments and Responses

- Hazardous waste management facilities that handle on-site generated wastes will be likely to maintain the facility responsibly. The test provisions should therefore be less stringent for such firms.

The Agency believes that business failure can strike either on-site or off-site disposers, and that both should be required to provide the same assurances of financial responsibility.

Final Regulation

The final regulation does not distinguish between on-site and off-site disposers.

E. Level of Financial Assurance Provided

Several commenters on the May 19, 1980 financial test and guarantee proposal discussed the effectiveness of the financial test.

1. Comparability to Alternative Financial Assurance Mechanisms

Some commenters argued that a financial test would provide better results than those obtained with other approved mechanisms of financial responsibility, and other commenters said that it would be less effective.

Comments and Responses

- Firms using the financial test may be as secure as the banks, sureties, or insurance companies supplying alternative financial assurance mechanisms.

EPA did not attempt to analyze in detail the likelihood of failure of banks, surety companies, or insurance companies, or to compare those failure rates to the measure of effectiveness it developed for financial tests. It is of course true that where a firm uses a secured financial assurance mechanism, such as a surety bond, no loss will occur unless both the firm and the surety fail, whereas if a firm uses the financial test, a loss could occur if it alone fails. However, the Agency believes that the test it has adopted provides adequate protection, while minimizing the costs of financial assurance.

- A financial test will not provide adequate financial assurance.

The study performed by the Agency and described in this Background Document was designed to test whether a financial test could provide adequate financial assurance. The study demonstrated that a financial test can do so, and the Agency therefore does not agree with this comment.

- The EPA may be unable to recover funds from a firm in bankruptcy proceedings.

The Agency has studied the prospects for its recovery of funds in bankruptcy proceedings. In general, the Agency's study suggests a strong likelihood that recovery can be had in bankruptcy proceedings; such recovery, however, may be limited. Assumptions derived from this study about the likely rates of recovery were used in the analysis of the costs of various financial test. (See Appendix B, Section III-E.) The Agency determined, through sensitivity analysis, that these assumptions were not critical variables in the costing procedure.

Final Regulation

The Agency studied the comparability of financial tests with other mechanisms of financial assurance promulgated on January 12, 1981. It is convinced that a financial test can appropriately be offered as an alternative to the trust fund, letter of credit, and surety bond options promulgated earlier.

2. Collateral Effects on Alternative Financial Assurance Mechanisms

Commenters argued that the existence of a financial test would create adverse effects on other mechansims of financial assurance.

Comments and Responses

- The rates charged for other financial mechanisms will be raised by a financial test, because only small firms, with greater risks of insolvency, will be required to obtain them.

The Agency recognizes the possibility that allowing a financial test could reduce the market for other mechanisms of financial responsibility, particularly the bonds and letters of credit. However, the requirements that firms using the financial test have at least $10 million in net worth and be independently audited will mean that a large number of viable firms will not qualify for the use of the test, and will therefore create a demand for the other financial mechanisms. The rates for the bonds and letters of credit, moreover, are based on the credit worthiness and other considerations presented by the individual owner or operator and would not be significantly affected by the size or strength of other owners and operators using the same mechanism.

In addition, the trust fund mechanism is likely to be available irrespective of the extent to which the financial test is employed, and the Agency expects that the insurance mechanism will be used by smaller firms which would not qualify for the financial test. Hence the Agency does not agree with this comment.

- Banks, sureties, and insurance companies will be reluctant to provide financial assurance instruments to companies that cannot pass the financial test.

Banks, surety companies, and insurance companies each perform their own financial analysis of applicants for their services. This analysis is designed to identify weak firms according to specific criteria set by each financial institution. Although the fact that a firm cannot qualify to use the financial test may in some instances be considered as one criterion by a bank, surety company or insurance company in an analysis to determine whether to provide another financial assurance mechanism, the Agency does not believe that the financial test results will be adopted as the sole determining factor by banks, surety companies or insurance companies. Each of these financial institutions has, for example, developed and maintained its own independent criteria and analytic techniques specifically adopted to its own business purposes. They have not adopted a uniform approach among themselves. Other financial responsibility provisions adopted by other agencies have not been substituted for these specially adapted techniques.

Even if, in some cases, weak firms which cannot pass the financial test also cannot obtain letters of credit, surety bonds, or closure insurance policies, trust funds will continue to be available to them.

- If a financial test is not allowed, smaller firms will be unable to obtain trust funds, surety bonds, etc., because they will be outbid for such services by firms that would otherwise use a financial test.

The Agency does not agree with this comment. It expects trust funds to be available under all circumstances. However, because a financial test is being allowed, the question is moot.

F. Reporting Requirements

The financial test proposed on May 19, 1980 required an owner or operator seeking to use the test to demonstrate the necessary financial characteristcs by submitting a financial statement. A large number of comments were received on the details of this reporting requirement.

1. Type of Financial Statements Required

The May 19, 1980 proposed regulation required that a financial statement audited by an independent certified public accountant, and containing unconsolidated balance sheets, be submitted by the owner or operator to qualify for the financial test.

Comments and Responses

- A requirement should be added that the financial statement submitted must be certified by an officer of the firm to establish a greater degree of responsiblity for both the owners or operators and the accountant.

The Agency agrees with this comment. The regulation now requires a letter from the Chief Financial Officer of a firm seeking to pass the financial test certifying that the firm meets the required standards. In addition, the firm must submit a copy of the independent Certified Public Accountant's report on examination of the firm's financial statements for the latest completed fiscal year, together with a special report from the CPA stating that he has compared the data set forth in the chief financial officer's letter with the amounts set forth in the financial statements, and no matters have come to his attention which cause him to believe that the specified data should be adjusted.

- Unconsolidated balance sheets should not be required, since unconsolidated data are ordinarily not reported.
- The phrase "unconsolidated balance sheet" is not clearly defined. It can either refer to a parent company separate from its subsidiaries or a U.S. entity separate from its foreign subsidiaries, or both.

The Agency agrees that unconsolidated balance sheets are not necessary. The statement that such data ordinarily are not reported is correct. The Agency therefore is not requiring unconsolidated balance sheets.

- Instead of unconsolidated data, the Agency should require financial information about the lowest corporate entity (i.e., a subsidiary) that has ownership of a treatment, storage or disposal facility.

The corporate guarantee provision in the regulation allows an entity with consolidated data to guarantee the financial responsibility of a subsidiary. Furthermore, the Agency is no longer requiring unconsolidated data. A firm could, of course, arrange to provide an independent audit for a subsidiary owning a facility if it desired to do so.

- Instead of the proposed reporting requirements, the Agency should use the requirements for reporting to the SEC and to stockholders for publicily held firms and an annual audit plus an opinion letter from a CPA for privately held firms.
- The reporting requirements established by this proposed regulation do not correspond to SEC reporting requirements.
- New disclosures should not be added to those financial disclosures already required by the SEC.

- Instead of the required financial statements, the Agency should substitute quarterly published statements that include balance sheets, such as the SEC Form 10Q.

- Use of already available financial reports supplemented by a letter from company management should be permitted.

The Agency has sought to avoid requiring any data that are not currently prepared in the course of an independent audit, and are not required by other governmental agencies, such as the SEC. Beacuse of the large number of hazardous waste facilities, however, the Agency has required that the necessary data be placed in the format of a letter from the chief financial officer which can be used for the purposes of the financial test without adding significant administrative burdens or requiring high levels of financial expertise on the part of Agency personnel.

The Agency has determined that the letter from the chief financial officer must be based upon an independent audit and accompanied by two reports from an independent Certified Public Accountant: (1) a copy of the CPA's report on examination of the owner's or operator's financial statements for the latest completed fiscal year, and (2) a special report from the CPA stating that he has compared the data set forth in the chief financial officer's letter with the amounts set forth in the financial statements, and no matters have come to his attention which cause him to believe that the specified data should be adjusted.

Since the purpose of submitting a copy of the auditor's report on examination of the financial statements is to provide the Agency with assurance from an independent source that the financial statements were prepared in accordance with generally accepted accounting principles and present the results fairly and consistently, the Agency cannot allow use of the financial test where the auditor gives a qualified opinion, an adverse opinion or a disclaimer of opinion regarding the owner's or operator's financial statements. The American Institute of Certified Public Accountants has set standards as to what qualified opinions, adverse opinions, and disclaimers of opinion should say and when they should be issued.

1. Qualified Opinion

   A qualified opinion states that "except for" or "subject to" the effects of the matter to which the qualification relates, the financial statements present fairly financial position, results of operations, and changes in financial position in conformity with generally accepted accounting principles consistently applied. Such an opinion is expressed when a lack of sufficient competent evidential matter or restrictions on the scope of the auitor's examination have led him to conclude that cannot express an unqualified opinion, or when the auditor believes, on the basis of his examination, that

   a. the financial statements contain a departure from generally accepted accounting principles, the effect of which is material,

   b. there has been a material change between periods in accounting principles or in the method of their application, or

   c. there are significant uncertainties affecting the financial statements, and he has decided not to express an adverse opinion or to disclaim an opinion.

2. Adverse Opinion

   An adverse opinion states that financial statements do not present fairly the financial position, results of operations, or changes in financial position in conformity with generally accepted accounting principles. Such an opinion is expressed when, in the auditor's judgment, the financial statements taken as a whole are not presented fairly in conformity with generally accepted accounting principles.

3. Disclaimer of Opinion

> A disclaimer of opinion states that the auditor does not express an opinion on the financial statements. When the auditor disclalims an opinion, he should state in a separate paragraph(s) of his report all of his substantive reasons for doing so, and also should disclose any other reservations he has regarding fair presentation in conformity with generally accepted accounting principles or the consistency of their application. The disclaimer of opinion is appropriate when the auditor has not performed an examination sufficient in scope to enable him to form an opinion on the financial statements. A disclaimer of opinion should not be expressed because the auditor believes, on the basis of his examination, that there are material departures from generally accepted accounting principles.
>
> (Statement on Auditing Standards No. 2, Reports on Auditied Financial Statements, AICPA, 1974, paragraph 29, 41, and 45.)

If the firm receives either an adverse opinion or a disclaimer of opinion, in the Agency's view the scope of the audit is not sufficient to confirm whether or not the firm satisfies the financial test.

The Securities and Exchange Commission will not accept adverse opinions or disclaimers of opinion and discourages qualified opinions in connection with filings involving the sale of securities to the public.

Firms receiving either adverse opinions or disclaimers of opinion must provide assurance of financial responsiblity using mechanisms other than the financial test. The Agency was aware that when auditors express opinions with "going concern" implications, the probability that the firm will fail within a short time is high. A study by Edward B. Deakin showed that 20.6 percent of firms which auditors classified as failing in 1971 later failed. Auditors were considered to have classified firms as failing if they had issued an opinion that refers to ability to continue profitable operations or to meet existing debts as they come due or to a going concern exception, or had disclaimed an opinion for going-concern related reasons. (See "Business Failure Prediction: An Empirical Analysis" in Financial Crises: Institutions and Markets in a Fragile Environment, edited by E.I. Altman and A.W. Sametz, New York: John Wiley & Sons, 1977, p. 85.)

The Agency recognized that opinions with "going concern" implications might not be expressed as straightforwardly as adverse or disclaimer of opionion. If the Agency judges, however, that the opinion raises questions as to whether the firm will continue as a "going concern," the Regional Administrator will disallow use of the financial test. Other qualified opinions will be evaluated on a case by case basis.

Requiring that firms be independently audited in order to qualify for the financial test will mean that the Agency will not have to undertake a detailed financial analysis of previously unreviewed data. The fact that almost all firms which are publicly held must also submit independently audited financial statements to the SEC by 90 days after the end of their fiscal year will provide a second measure of assurance that almost all of the data will be accurate. Finally, the Agency developed the financial test provision from information available on independently audited consolidated income acounts and balance sheets because it could not determine the accuracy of non-audited data, or the effects on the financial test results of errors in non-audited data.

The requirement for a special report from the auditor was adopted by the Agency to ensure that there is a fair representation of the results obtained through the independent audit in the chief financial officer's letter. Independent auditors are familiar with the preparation of special reports. The use of such a report will relieve EPA personnel of searching balance sheets and income statements to verify the accuracy of statements made in the letter from the chief financial officer.

Final Regulation

The regulation requires a firm seeking to use the financial test to provide a letter from the chief financial officer certifying that the firm meets the required standards, based upon the independently audited year-end financial statements and footnotes for the most recently completed fiscal year. The chief financial officer must certify the levels of the required financial measures, and that they meet or exceed the levels required by the regulation.

In addition, the regulation requires a copy of an independent Certified Public Accountant's report on his examination of the firm's financial statements for the latest completed fiscal year, together with a special report from the CPA stating that he has compared the data set forth in the chief financial officer's letter with the amounts set forth in the financial statements, and no matters have come to his attention which cause him to believe that the special data should be adjusted.

2. Time Schedule

The May 19, 1980 proposed regulation required that the financial statement be dated no more than 140 days prior to the current date. The proposal also required that if at any time during the operating life of the facility the owner or operator failed to meet the requirements of the test, he must notify the Agency by certified mail within 5 days of learning the failure to meet the requirements.

Comments and Responses

Commenters opposed both the requirement of quarterly financial statements, and the timing requirement for notice of changed circumstances.

- The 140-day requirement should be increased to at least 180 days.
- Financial statements are ordinarily prepared by an independent certified public accountant once a year. Requiring them more frequently will add considerably to the expense of the regulation.
- If quarterly data are required, the Agency should ask for 12 months of data, updated every three months.
- Quarterly data should not be required, since seasonal fluctuations in firm performance will be given unnecessary significance by such data.

The Agency has concluded that quarterly data are not required. The financial test it has developed provides adequate warning of bankruptcy using annual data. Use of quarterly data, or a moving average of annual data adjusted quarterly, would provide somewhat more stringent tests, but the results of such tests would not justify the additional paperwork and costs they would require.

However, the regulation does provide that if the Regional Administrator has reason to believe that the owner or operator may no longer meet the test criteria, he may request additional financial reports or other relevant information from the owner or operator. Upon a finding by the Regional Administrator that the owner or operator no longer meets the criteria, the owner or operator will be required to establish other financial assurance. Failure to provide alternate assurance when required, after disallowance or after no longer passing the test, will be considered a violation of RCRA regulations and cause for issuance of a compliance order or initiation of legal proceedings under Section 3008 of RCRA.

- Firms should be given 5 working days rather than calendar days to notify the Agency of change in status.

- Firms should be required to notify the Agency of a change in status only within a certain period after a quarterly or annual financial report is issued.

The Agency accepts the suggestion that the time period for notification of a change in status proposed in the May 19, 1980 financial test should be revised.

Final Regulation

The regulation provides that an owner or operator must send the chief financial officer's letter and the auditor's reports so that they are received by the Regional Administrator by the effective date of these regulations. Since the effective date of the regulations may come too soon after the end of an owner's or operator's fiscal year to allow adequate time to prepare the required documents based on data for the most recently completed fiscal year, the financial test provisions in Part 265 allow a one-time extension if an owner's or operator's fiscal year ends during the 90 days before the effective date and if the firm's financial statements are being independently audited. The extension may last up to the date 90 days after the end of the fiscal year. To obtain the extension the chief financial officer of the firm must send a letter to the Regional Administer by the effective date of these regulations. In the letter he must request the extension; certify that he has grounds to believe that his firm meets the financial test criteria; identify the facilities to be covered and their cost estimates; specify the date when the firm's fiscal year ended; specify

Reproduced from best available copy.

the date no more than 90 days after the end of the fiscal year when he will submit the documents required; and certify that the firm's year-end financial statements are being independently audited.

After the initial submission of the chief financial officer's letter and the auditor's reports, updated information consisting of a new letter from the chief financial officer and new auditor's reports must be received by the Regional Administrator annually within 90 days after the close of each suceeding fiscal year. The Regional Administrator may request additional information at any time if he has reason to believe that the owner or operator no longer meets the test criteria.

If the owner or operator no longer meets the criteria of the financial test he must send notice to the Regional Administrator, by certified mail within 90 days after the end of the fiscal year for which the year-end financial data show that he no longer meets the criteria, of intent to establish alternative financial assurance. The owner or operator must provide alternative financial assurance within 120 days after the end of such fiscal year.

3. Distinction between Domestic and Foreign Assets

The May 19, 1980 proposed regulation required that the financial statement show net worth and net working capital in the United States as well as total net worth and total working capital. Only net worth and net working capital in the U.S. could be used to qualify under the financial test.

Reproduced from
best available copy.

Comments and Responses

- o Many companies do not separate U.S. and foreign assets on their reports.
- o Obtaining data about U.S. resources will impose a high cost on firms that do not now generate such data.

The Agency has concluded that in order to ensure that it has legal access to the assets of firms that utilize the financial test, it is necessary to retain this requirement. Non-U.S. assets may be either so sheltered that they cannot be levied against easily, or so at risk that the Agency cannot be certain they will be available when needed.

Precedents for a requirement that U.S. assets be relied upon are present in both the Coast Guard Marine Oil Pollution self-insurance requirements (33 CFR §135.213(a)(1)), and the Federal Maritime Commission Water Pollution Financial Responsibility self-insurance requirements (46 CFR §542.8(a)(3)).

The Agency has determined that AICPA Professional Standards provide that information about the identifiable assets of foreign assets be presented in financial statements of an enterprise if the assets of the foreign operation are 10 percent or more of the consolidated total assets as reported in the enterprise's balance sheet, or if revenue generated by the enterprise's foreign operations from sales to unaffiliated customers is 10 percent or more of consolidated revenue as reported in the enterprise's income statement. The Securities and Exchange Commission also requires that firms filing Form 10K reports identify assets by location in or outside the U.S. if 10 percent or more of assets are located outside the U.S.. A firm with 10 percent or more of its assets outside the U.S. will therefore not have to take additional steps to identify the exact amount of assets in the U.S. in order to meet this requirement of the financial test.

- o A substantial percentage of the firm's activities (for instance, 75 percent) should be required to be performed in the U.S.

The Agency did not consider this a useful substitute for its requirement that the firm show U.S. assets six times greater than current closure and post-closure costs. A requirement of a substantial percentage of U.S. activities would eliminate many of the soundest and largest multi-national firms from using a financial test. Further, if a firm met all other elements of the financial test, it would be unlikely that U.S. assets could be overwhelmed by even more significant foreign liabilities. The Agency did, however, add the option that a firm need not meet the requirement of U.S. assets of six times current closure and post-closure costs if it has more than 90 percent of its assets in the U.S. This alternative method of meeting the U.S. assets requirements was added for firms that might not be required by SEC to report their U.S. assets separately.

Final Regulation

The test requires that a firm have assets located in the United States amounting to at least 90 percent of total assets or at least six times the sum of the current closure and post-closure cost estimates.

G. Corporate Guarantee

The proposed regulation of May 19, 1980 provided that an owner or operator could meet the financial responsibility requirements by obtaining the written guarantee of another entity for the amount of the estimated closure and/or post-closure costs. The entity providing the guarantee was required to qualify according to the terms of the financial test proposed on May 19, 1980, and to execute the guarantee instrument on a form which established specific terms required by the Agency.

The Agency received several comments concerning whether a guarantee should be allowed and pertaining to the terms of the guarantee.

1. Enforcement of Corporate Guarantee

Two comments questioned whether the Agency would be able to enforce a guarantee.

Comments and Responses

- The guarantee provision will not ensure that the costs of financial assurance will be paid.
- The EPA may not be able to secure payment of a guarantee if needed.

The Agency has revised the corporate guarantee instrument that it is requiring all guarantors to use. Clauses were added to the instrument in which the guarantor waives notice of acceptance and agrees to remain bound notwithstanding amendment or modification of the closure or post-closure plan or certain other modifications or alterations. The corporate guarantee obligation, in the opinion of the Agency, will be binding on the guarantor and will be enforceable in the same manner that other contracts are enforced. The Agency believes that these changes will help to preclude potential defenses to the obligation created by the corporate guarantee. The Agency has also provided that the corporate guarantee may be cancelled after 120 days notice to the subsidiary and the Regional Administrator. If the subsidiary does not establish approved alternative financial assurance within 90 days the guarantor must provide such assurance.

2. Terms of the Corporate Guarantee

Commenters recommended that the EPA not specify the terms of the guarantee.

Comments and Responses

- The guarantee provision unduly restricts parent firms that might provide a straightforward written guaranty that they are responsible for a subsidiary.

The Agency does not agree with this comment. It has concluded that uniform language is required for the financial assurance instruments, including the corporate guarantee. Such standard forms ensure that excessive efforts will not be required by the Agency to monitor the content of the instruments. They also avoid the expenditure of effort, time, and cost on the part of owners or operators to develop their own forms, and preclude any inequities caused by differing forms. The Agency is convinced that parent firms can provide straightforward corporate guarantees for their subsidiaries with the corporate guarantee instrument it has provided.

3. Accuracy of Underlying Financial Data

One commenter questioned whether the EPA could obtain accurate data from guarantors.

Comments and Responses

- The EPA will not have the authority over third party guarantors that will ensure that it obtains accurate reports of their financial condition.

The guarantor is required by the regulation to provide the same assurances that it passes the financial test as a firm seeking to qualify directly under the financial test provision. Thus, the guarantor must also provide a letter, based upon the independently audited year-end financial statements and footnotes for the immediately preceding fiscal year, from its chief financial officer, and a special report from an independent certified public accountant to accompany the letter. These data should be as accurate as that provided directly by an owner or operator.

4. Need for Guarantee

Several commenters supported the need for a guarantee provision.

Comments and Responses

The Agency agrees that a guarantee provision is desirable. It will allow parent corporations which are capable of passing the financial test to provide assurance of financial responsibility for their subsidiaries which may have fewer financial resources. The Agency believes this arrangement will help to reduce both the public and the private costs of the financial responsibility requirements.

Final Regulation

The final regulation provides that an owner or operator may meet the financial responsibility requirements by obtaining its parent company's corporate guarantee. The guarantor must meet the requirements of the financial test and must furnish the same financial test documentation. The wording of the corporate guarantee must be identical to wording specified by the Agency.

H. Revenue Test for Municipalities

The proposed regulation of May 19, 1980 provided that if an owner or operator was a municipality (as defined by RCRA), it could meet the closure and/or post-closure financial assurance requirements by having annual revenues from property, sales, and/or income taxes equal to 10 times the adjusted closure and/or post-closure cost estimates. To be acceptable, those tax revenues had to be legally available; that is, they could not be dedicated to other purposes or otherwise precluded from use in meeting the financial assurance responsibilities.

1. Likelihood of Municipal Default

Several commenters argued that municipalities do not fail, while other commenters suggested that municipal viability was not a complete assurance of financial responsibility.

Comments and Responses

- Local units of government should be exempted from financial assurance requirements since they meet their commitments.
- Municipalities should not be treated any differently from other entities. There is no guarantee that they will have funds when needed if they must go through the budgetary or legislative process to get the funds. Cities will be able to pay for closure but are not necessarily willing to when the time comes.
- The test seems like a reasonable approach. These costs will not pose a major problem. Local governments face so much pressure for environmental responsibility that there is no way hazardous waste facilities will not be closed.
- The revenue test is of little use because it doesn't tell us anything about the financial strength of the community. Few cities will flunk the test.

The Agency agrees that, in general, local units of government can be expected to meet closure and post-closure requirements in a conscientious manner. Public health is a fundamental concern of these units as it is for other levels of government. Furthermore, unlike a private party, municipalities generally cannot walk away from their facilities. Where there have been defaults on debts, municipalities eventually pay off or are assisted by the State to do so.

Table 4 shows municipal default experience under Chapter IX of the Bankruptcy Act. As can be readily seen, the number of municipal bankruptcies was low, and the recovery rate was high, particularly in recent years. The Agency also examined the wider record of total defaults on State and local debt, since not all defaults are dealt with through Chapter IX. Table 5 shows the total default record for the period 1920 to 1965.* For the period 1945 to 1965, there were a total of 329 defaults of all kinds. Of these, 266 defaults were recorded only in the records of banks, and many of these were considered by the compiler of these data to be purely temporary or technical defaults resulting from inexperience on the part of municipal finance officers rather than representing any serious financial distress. Table 6 compares the default record of various kinds of municipalities to the failure records of businesses for the period 1960 to 1965.

---

*This record of defaults is the result of a careful study of the municipal default record examining a variety of sources of default data. In part because of the rarity of default events, there is no single data base from which the total number of municipal defaults can be gathered, and this record cannot therefore be brought up to date.

TABLE 4

MUNICIPAL DEFAULT EXPERIENCE UNDER CHAPTER IX

Period	Number of Municipal Cases Filed[a]	Recovery Rate For Cases Filed and Concluded[b]	Total Business Bankruptcy Cases Filed[c]
1938-40	210	66%	-
1941-50	115	65%	56,766
1951-59	27	75%	89,880
1960-72	10	95%	211,340
1973-79	7	-	195,785

---

[a] Source: Hempel, George H. The Postwar Quality of State and Local Debt. Columbia University Press, New York, 1971.

[b] Percentage of admitted debt in default ultimately paid for cases filed and concluded.

[c] Source: Tables of Bankruptcy Statistics. Administrative Offices of the United States Courts, 1980.

TABLE 5

DEFAULTS ON STATE AND LOCAL DEBT

	1940-49	1950-59	1960-65	Number of Governmental Units-1962
States	0	0	0	50
Counties and Parishes	6	12	17	3,043
Incorporated Municipalities	31	31	70	17,997
Unincorporated Municipalities	7	4	20	17,144
Special Districts	5	23	41	34,678
Other	30	42	44	18,323

Source: Hempel, George H. The Postwar Quality of State and Local Debt. Columbia University Press, New York, 1971.

TABLE 6

LOCAL GOVERNMENT ANNUAL DEFAULT RATE COMPARED TO AVERAGE BUSINESS FAILURE RATE (1960-65)

(defaults or failures per 10,000 entities)

Counties and Parishes	Incorporated Municipalities	Unincorporated Municipalities	Special Districts	Other	Business Failure
9	6	2	2	4	57

Derivation: Local governments from Table I; business failures from Dun & Bradstreet, The Failure Record Through 1978, Dun & Bradstreet, 1979.

However, the Agency is concerned that if funds have not been set aside by a municipality for the purpose of closure and post-closure care, it may face difficulties in allocating those funds when they are needed, and securing timely closure and post-closure care is an important goal of the financial responsibility requirements. If budgetary and legislative processes, bond issues, or voter approval of new taxes are necessary, it may be some time before funds become available. Even with the best intentions, municipalities may feel forced to put off closure and post-closure activities because of other, unexpected, seemingly more urgent demands for funds. The relative freedom of municipalities from default does not take care of this problem.

2. Municipal Ability to Shift Expenditures

The revenue test proposed on May 19, 1980 assumed that municipalities would be able to adjust their expenditures to provide for closure and post-closure care.

Comments and Responses

- The notion that a municipality can reallocate 10 percent of its budget in any year is unrealistic. A level of 5 percent might be more easily reallocated.
- The wording of the revenue test, "10 times adjusted closure and post-closure cost," is ambiguous and should instead make reference to a percentage of revenue.

As described in Section A.5. above, the Agency has found few studies providing empirical data on the level of budget reallocation (or cuts from other services) a municipality can reasonably accommodate without diverting large sums of money away from other essential public services. A report by the Advisory Commission on Intergovernmental Relations has looked at eight cities that had experienced severe financial problems in the recent past. Of the eight cities in the study, only two resorted to reductions in expenditures. Although both cities reduced their expenditures by over 10 percent in one year, the report concluded that the case studies did not provide an answer to the question of how far services could be reduced or taxes increased without serious consequences to cities in financial trouble. The studies do indicate that sharp deviations from the normal level of expenditures can be difficult for cities to manage.

A majority of comments received from local officials and other individuals knowledgeable in local finances, as well as the literature on the subject, have stressed the fact that there is no slack in local budgets, and some cities are in severe financial straits. The majority of comments received concurred with the ACIR data that suggests a 10 percent budget reallocation would be possible only in extreme situations.

Data in the U.S. Census of Governments indicate on average that except for such major services as police protection and education, which represent 11.5 and 13.6 prcent respectively, no municipal expediture category exceeds 8.2 percent of annual municipal expenditures. Municipal services such as fire protection, sanitation, health, sewage, and parks and recreation correspond to annual expenditure percentages well below the 10 percent level. The Agency believes that it is unreasonable to expect a municipality to afford an unplanned expenditure that amounts to 10 percent of the municipality's uncommitted revenues. Although the ACIR study has shown that cuts as large as 10 percent have been implemented in two cities experiencing severe financial crises, the Agency believes that the revenue test should not be based on this level of expenditure reduction.

Several studies on the financial condition of local governments have indicated that while many units of government are experiencing financial problems, small communities have unique fiscal problems. These factors may raise doubt as to a small community's ability to close in a timely manner if closure and post-closure costs comprise too large a portion of uncommitted revenue and the closure and post-closure costs were not already provided for.

For these reasons, the Agency finds merit in criticism of the proposed multiple of 10. The Agency has also not been able to find strong empirical support for the argument that a larger multiple, such as the suggested multiple of 20, will provide satisfactory assurance. The evidence is not clear that all municipalities will be able to shift expenditures rapidly to closure or post-closure, irrespective of the multiple adopted.

Final Regulation

The Agency has therefore decided not to adopt the proposed revenue test for municipalities.

3. Suggested Alternative Municipal Tests

Commenters suggested several additions to, or substitutes for, the proposed revenue test.

Comments and Responses

- o The revenues derived from taxes alone do not give the whole picture of a municipality's financial situation. The phrase ". . .from property, sales, and/or income taxes. . ." should be deleted. All income should be considered.

The Agency investigated the question of whether municipal income could be increased quickly to satisfy financial assurance requirements. It concluded that it is not reasonable to assume that any of the traditional sources of income (e.g., taxes, fees, borrowing, and intergovernmental transfers) could be expanded quickly.

Taxes:

The general property tax traditionally has formed the largest component of local government revenues. It has been moderately elastic, expanding with population increases and growth of the economy, but also contracting significantly during the Great Depression. It has recently, in some parts of the country, become the subject of publicly-initiated tax limitation or reduction movements. Over time, the property base of the tax can be eroded by the growth of tax exempt property, or by the decline in value of taxable property. Property tax revenues do not respond as quickly as expenditures to inflation.

Local governments also rely, to a lesser but growing degree, on sales and income taxes. Both types of tax are strongly elastic. With few exceptions, the use of the income tax as a source of local revenue has been limited to urban areas in a relatively few states. In those cases, however, income taxes are frequently at least as important as property taxes in providing fiscal support to the local government.

Local sales taxes are more widespread, and overall they provide the greatest amount of non-property tax revenue. Frequently, however, their use is restricted by the States.

Because local property, sales, and income tax receipts are all closely, although not absolutely, dependent on the economic situation of the locality collecting the tax, they can vary markedly over time. Particular indicators of a government's revenue-raising capacity, such as data on personal incomes, the volume of retail trade, and property values, can be measured. However, it would not be administratively feasible for the Agency to monitor such measures for each local government operating a hazardous waste TSDF, nor is it clear that the trend of such measures would prove to be an adequate predictor of the long-term fiscal situation of the local government, and hence its future ability to provide closure and post-closure care. (See ACIR, Measuring the Fiscal Capacity and Effort of State and Local Areas, 1971.)

Tax receipts are also dependent on political decisions. The ACIR has attempted, in cooperation with State revenue departments, to determine whether selected state tax collection increases in the past decade were due to economic or political factors. Their findings suggest that, at least for states, there has been a reluctance to take conscious political action to raise taxes. Recent increases in tax collections have been primarily attributable to inflation, and secondarily to growth in the economy.

The Agency therefore decided that it would not attempt to develop a financial assurance mechanism dependent on increases in taxation.

Fees:

Numerous local governments operate public service enterprises which take in fees paid by the customers of the enterprise. Such fees, however, may be insufficient to fully cover the costs of the service, and subsidies are sometimes paid from other sources of revenue to the enterprise. Even if the enterprise does operate with a surplus of fees over costs, such fees are frequently pledged for the repayment of the bonds that financed the facility. Localities are often forbidden to use fees to raise general revenue. There is some evidence that smaller local governments are more likely than the larger jurisdictions to diversify and expand their revenues by adopting fees. (*See* ACIR, *Local Revenue Diversification: Income, Sales Taxes and User Charges*, 1974.)

Public entities that are entirely dependent for their revenues upon fees are essentially identical to private entities, and are subject to the same fluctuations in revenue as private firms. Such public enterprises have occasionally been forced to default on their bonded indebtedness, and the incidence of their defaults has been higher than for other units of local government.

Borrowing:

Public debt has traditionally been used to finance capital expenditures for projects with long productive lives. Payments are spread out over time and fall on those generations of citizens who can expect to derive benefits from the investments.

A local jurisdiction adhering to these principles might choose to treat its hazardous waste facility as a capital project, and include the amount estimated for closure in the debt contracted for the project at the beginning of its life. Such debt could then be repaid from the proceeds over the life of the facility.

If, however, the facility has been in existence for some time, and the local jurisdiction seeks to borrow to obtain the resources for closure or post-closure care at the time such funds are needed, several problems could result. Funds may not become available in a timely fashion, since local debt must usually be approved directly by the voters. The amount of such debt could be limited by debt ceilings imposed by the State. In addition, the use of short-term debt to finance current expenses is frequently discouraged as a potential contributing factor to municipal default. The Agency therefore decided it would not attempt to develop a financial assurance mechanism dependent on local debt.

Intergovernmental Transfers:

Intergovernmental transfers currently provide a large portion of the aggregate revenue of local governments. Such transfers include not only Federal General Revenue Sharing, but also other forms of direct federal aid, and state aid to localities. Significant differences exist, however, in the extent to which different local governments rely on their own source revenues or on federal or state aid. In addition, many intergovernmental transfers are in specific functional areas (e.g., highways, employment security, education, health, public welfare, and counter-cyclical programs) rather than being undesignated funds available to be spent on projects chosen at the discretion of the local government. There are indications that direct federal transfers to local governments may decline in the future, and it is not yet clear whether State aid to local governments will be increased by a proportionate or greater amount. (See ACIR, Recent Trends in Federal and State Aid to Local Governments, 1980; The State of State-Local Revenue Sharing, 1980; National Governor's Association, Allocation of State Funds to Local Jurisdictions, 1980.) There is also some evidence that larger cities place greater reliance on intergovernmental transfers than do smaller jurisdictions.

Several commenters suggested that the most desirable form of financial assurance for a municipality would be a guarantee for its closure or post-closure costs from the State in which it was situated.

The January 12, 1981 regulations provide that:

> If a State either assumes legal responsibility for an owner's or operator's compliance with the closure, post-closure or liability requirements of these regulations or assures that funds will be available from State sources to cover those requirements, the owner or operator will be in compliance with the requirements of this subpart if the State's assurances are equivalent to or exceed the assurances provided by the requirements of this Subpart.
>
> 46 FR 2861

The Agency found several reasons why an assumption of legal responsibility by a State to provide funds for closure and post-closure care for a municipality is appropriate.

Benefits from a municipal TSDF would probably extend to surrounding communities, and problems arising at such a TSDF would almost certainly have impacts outside the immediate municipality. State involvement would help spread the costs of the benefits or burdens of the site over more of the affected citizens.

Such a State guarantee would follow current trends toward greater State involvement in local finances. The fiscal position of the States has improved since the 1950's and 1960's vis-a-vis both the federal government and local governments. This has resulted in a modest increase in State aid to local governments (see ACIR, The States and Intergovernmental Aids: The Intergovernmental Grant System, at 1-13 (1977); ACIR, Recent Trends in Federal and State Aid to Local Governments, at 1-15 (1980); ACIR, The State of State-Local Revenue Sharing at 3 (1980); ACIR and National Academy of Public Administration, The States and Distressed Communities: The 1980 Annual Report, (1980)). In addition, State-imposed limits on taxation or State-required expenditures frequently limit the control of local governments over significant parts of their own budgets (see ACIR, State Limitations on Local Taxes and Revenues (1977); ACIR, State Mandating of Local Expenditures (1978)).

- Since quasi-state organizations do not have taxing authority, a project undertaken by such an authority must be self-sustaining and based on the revenues of such projects. These organizations should be required to meet specific financial requirements parallel to those proposed for private entities.
- The Agency should allow uncommitted revenues from user charges and contracted revenues to be used to meet the financial assurance requirements.

The Agency agrees that "authorities" and other public entities that are primarily dependent upon fees for their revenues should be considered essentially identical to private entities and should be allowed to meet the same financial assurance requirements. Thus, if such entities can qualify under the financial test, they will be allowed to do so.

- Several commenters said that bond service ratings should be considered as an element of the revenue test, but other commenters on the use of bond ratings were generally of the opinion that bond ratings were not particularly accurate indicators of a community's financial health.

Municipal bond ratings have been said to take into account the subjective impressions of the rating service and the past history of the municipality to the extent that changes in a municipality's rating often follow a financial event rather than predict it. In the major default era of 1929 to 1937, 78 percent of all defaulted municipal bond issues and 94.4 percent of the dollar value of all defaulted municipal bond issues were rated in the top two categories by both major rating services. Also, an analysis of the defaults of public corporation revenue bonds since WW II has shown the ratings at the time of purchase were not lower for corporations that ultimately defaulted than for those that did not. Because of these anomalies, and the questions about timely allocation of funds discussed earlier, the Agency has decided not to allow a revenue test based on municipal bond ratings.

- The Agency should design a revenue test for municipalities incorporating a minimum net worth test to eliminate those municipalities that are on the verge of bankruptcy.

The Agency has considered the use of detailed financial information to determine the current financial solvency of municipalities, but has decided not to use this approach at the present time. Municipal accounting and reporting procedures vary greatly (see Coopers & Lybrand and the University of Michigan, Financial Disclosure Practices of the American Cities: A Public Report, 1976; Coopers & Lybrand, Financial Disclosure Practices of the American Cities II: Closing the Communications Gap, 1978). In addition, the financial statements and audits of local governments are frequently not released in a timely way. The Agency has therefore concluded that it cannot specify a set of financial indicators similar to the financial test that would be suitable for municipalities.

4. Definition of Municipality

Several commenters questioned whether a clear distinction could be made between a State and a municipality.

Comments and Responses

- It is not clear whether some entities are municipalities or are part of the State and therefore qualify for the State exemption.

RCRA itself provides a definition of both "State" and "municipality":

> "(31) The Term 'State' means any of the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.
>
> "(13) The term 'municipality' (A) means a city, town, borough, county, parish, district, or other public body created by or pursuant to State law, with responsibility for the planning or administration of solid waste management, or an Indian tribe or authorized tribal organization or Alaska Native village or organization, and (B) includes any rural community or unincorporated town or village or any other public entity for which an application for assistance is made by a State or political subdivision thereof.
>
> 42 U.S.C. §6903

The financial responsibility regulations, in turn, provide that "States ... are exempt from the requirements of this ... [financial assurance] Subpart." 46 FR 2851.

Several commenters have stated that these provisions are inadequate to resolve all cases of ambiguity about whether an entity should be classified as a State or a municipality. In particular, they believe that the law and regulation, read together, do not make it clear whether a "district or other public body" created by State law for the purpose of handling hazardous waste should be treated as a "municipality" and required to provide assurances of financial responsibility. If so, they argue, the exemption already granted to the States would be very narrow, and the States could be discouraged from setting up hazardous waste facilities.

The Agency generally believes that the treatment of each of those facilities may have to be determined according to its individual facts. A facility is exempt from the requirements of this regulation if it is owned or operated by a State. "Districts or other public bodies" created by State law for the purpose of handling hazardous wastes would be exempt only if they were instrumentalities of the State and the State were fully liable for their obligations.

Commenters also questioned whether the distinction between municipalities and private entities was clear.

- o Some private business could incorporate and pay taxes sufficient to meet the municipal revenue test requirements. This "municipality" may not provide adequate financial assurance and the regulations should preclude this possibility.

The Agency recognized that determining the legitimacy of municipalities for the purpose of a revenue test was a difficult problem. Because the revenue test has been withdrawn, however, the Agency believes that the problem of "sham" or "company" towns need not be addressed. Both municipalities and private owners and operators are required to obtain assurances of financial responsibility.

5. Other Issues

Several commenters suggested minor refinements or variations in the proposed revenue test. Since the Agency has withdrawn that test, those comments are not responded to here. In addition, the following issues were raised:

- The Agency should allow municipalities to guarantee the closure obligations of other public and private entities. A municipality that currently disposes of its hazardous waste outside of its borders or through a private owner or operator might want, in order to ensure the continued availability of the service, to guarantee that it will provide funds for closure care.

The Agency has reviewed municipal law on the subject of guarantees and has determined that reliance on a municipal guarantee could leave the Agency without the financial assurance it feels is necessary. In particular, a municipal corporation can only act within the bounds of its charter, and it will be limited by the State constitution, by statutes passed before the guarantee was undertaken, and even in some cases by statutes enacted after the guarantee was undertaken. The Agency would have to ascertain in each case whether the legislative charter and other State law gave the municipality the express power to act as a guarantor. Otherwise, it could later be faced with a determination that the contract was void because it was outside the power of the municipality. The Agency therefore determined that municipal guarantees should not be allowed as an option at the present time, since financial assurance could not be adequately guaranteed without an extensive analysis of the legal powers of each municipality offering a guarantee.

- o Federal and State authorities are likely to be more reluctant to prosecute a governmental entity than a private offender; therefore, a stringent test is required.

- o **Funds may be obtainable but enforcement efforts may be weak or ineffective.**

The Agency does not expect that the closure obligations of a publicly owned or operated hazardous waste facility will be enforced any less vigorously than the closure obligations of a private entity. The Agency does believe however, that legal enforcement proceedings can be more complicated when brought against a municipality. Difficult issues of federal-state-municipal relations may have to be dealt with. This is another factor that argues against a revenue test. Publicly owned or operated facilities, however, also offer options that private entities do not which may allow the Agency to secure timely closure by avoiding litigation. In addition to the legal option available to the Agency, there are public pressures from State agencies and from the local citizenry, who can be expected to be sensitive to the need for proper management of hazardous waste facilities.

- o Municipalities should be allowed to use the financial test if, because of their financial structure, they can fulfill its requirements.

- o If a State were to guarantee the closure and post-closure obligations of a municipality, does the municipality still have to provide other financial assurance?

The regulations point out that a hazardous waste facility must demonstrate that it has established or meets the criteria of one of the financial assurance mechanisms, or that the State has guaranteed these obligations. Therefore, an entity that can demonstrate that its closure obligations are backed by the State need not provide the Agency with any other form of assurance. Also, an entity that meets the requirements of the financial test may choose to demonstrate financial assurance through this test or may utilize any one of the other financial mechanisms. The Agency believes that trust funds, letters of credit, and surety bonds will be available to municipalities.

I. Other Issues

Comments and Responses

- RCRA does not authorize the use of a financial test or self-insurance to provide assurance of financial responsibility.

The Agency has carefully reviewed its legislative mandate to authorize the use of a financial test and self-insurance to provide assurances of financial responsibility. Its basic conclusion that such mechanisms were authorized by Congress, and its reasons for reaching that conclusion, are described in Section II of this Background Document.

- Review AICPA Professional Standards text for definitions of financial terms.

The Agency sought to adopt the conventional definitions of terms. It recognizes that the definitions may not provide the precise meanings of terms in all particular cases, but do provide general guidance which can be used to satisfy these requirements. As stated in the regulations, "the definitions are not intended to limit the meaning in a way that conflicts with general usage." The Agency will continue to consider specific suggestions on how the definitions can be improved.

BIBLIOGRAPHY

Altman, E.I., Corporate Bankruptcy in America, Lexington, Mass.: D.C. Heath, 1971.

Altman, E.I., "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," The Journal of Finance, 23 (September 1968), pp. 589-609.

Altman, E.I., "Predicting Railroad Bankruptcies in America," Bell Journal of Economics and Management Science, 4 (Spring 1973), pp. 184-211.

Altman, E.I., "The Z-Score Bankruptcy Model: Past, Present, and Future," Financial Crisis: Institutions and Markets in a Fragile Environment, Edward I. Altman and Arnold W. Sametz, ed., New York: John Wiley & Sons, Inc., 1977, pp. 89-107.

Altman, E.I., G. Haldeman and P. Narayanan, "ZETA Analysis: A New Model to Identify Bankruptcy Risk of Corporations," Journal of Banking and Finance, 1 (1977), pp. 29-54.

Altman, E.I. and T.P. McGough, "Evaluation of a Company as a Going Concern," The Journal of Accounting, December 1974, pp. 50-57.

Altman, E.I. and W. Sametz, ed., Financial Crises: Institutions and Markets in a Fragile Environment, New York: John Wiley & Sons, Inc., 1977.

Argonne National Laboratory, Western New York Nuclear Service Center Study, Companion Report, Office of Nuclear Waste Management - U.S. Department of Energy, Washington, D.C., 1978, TID-28905-2.

Atkinson, T.B. with E.T. Simpson, Trends in Corporate Bond Quality, New York: National Bureau of Economic Research, 1967.

Backer, M. and M.L. Gosman, Financial Reporting and Business Liquidity, New York: National Association of Accountants, 1978.

Beaver, W.H., "Financial Ratios as Predictors of Failure," Empirical Research in Accounting: Selected Studies, 1966, supplement to Vol. 5, Journal of Accounting Research, pp. 71-102.

Beaver, W.H., "Market Prices, Financial Ratios, and the Prediction of Failure," Journal of Accounting Research, 6 (Autumn 1968), pp. 179-192.

Bernard, H., "Love Canal - 2030 A.D.," *U.S. EPA National Conference on Management of Uncontrolled Hazardous Waste Sites (Washington, D.C., October 15-17, 1980)*, Hazardous Material Control Research Institute, Silver Spring, Md.

Blum, W.J., "The 'Fair and Equitable' Standard for Confirming Reorganizations Under the New Bankruptcy Code," 54 *American Bankruptcy Law Journal*, 165 (1980).

Booz, Allen, and Hamilton, Inc. and Putnam, Hayes and Bartlett, Inc., *Hazardous Waste Generation and Commercial Hazardous Waste Management Capacity*, U.S. Environmental Protection Agency, Washington, DC, 1980.

Cherin, R.E., H.L. Ash and J.H. Burlingame, "Enforceability of Guarantees and Other Credit Support Provided Among Members of a Corporate Group: A Bibliography," 34 *The Business Lawyer*, 2029 (1979).

Clark, B., "Preferences Under the Old and New Bankruptcy Acts," 12 *Uniform Commercial Code Law Journal*, 154 (1979).

Clark, R.C., "The Duties of the Corporate Debtor to its Creditors," 90 *Harvard Law Review*, 505 (1977).

"Comment: Business Reorganization Under the Bankruptcy Reform Act of 1978: An Analysis of Chapter 11," 1979 *Brigham Young University Law Review*.

Dames & Moore - Environmental and Applied Earth Sciences Division, *Assessment of the Levels, Potential Origins and Transport Routes of the Radioactivity Measured in the Vicinity of the Maxey Flats Low-Level Radioactive Waste Disposal Site*, White Plains, New York, March 1977.

Deakin, E.B., "A Discriminant Analysis of Predictors of Business Failure," *Journal of Accounting Research*, 10 (Spring 1972), pp. 167-179.

Deakin, E.B., "Business Failure Prediction: An Empirical Analysis," *Financial Crises: Institutions and Markets in a Fragile Environment*, Edward I. Altman and Arnold W. Sametz, ed., New York: John Wiley & Sons, Inc., 1977, pp. 72-87.

Dragonette, K., J. Blackburn and K. Cartwright, *Interagency Task Force Report on the Proposed Decommissioning of the Sheffield Nuclear Waste Disposal Site*, Illinois Department of Public Health, Illinois Institute of Natural Resources, U.S. Nuclear Regulatory Commission, September 1979 (U.S. NRC Docket No. 27-39).

Dun & Bradstreet Corporation, *The Business Failure Record*, New York, 1979.

Edmister, R.O., "An Empirical Test of Financial Ratio Analysis for Small Business Failure Prediction," *Journal of Financial and Quantitative Analysis*, 7 (March 1972), pp. 1477-1493.

Edwards, R.C., "Stages in Corporate Stability and the Risks of Corporate Failure," *Journal of Economic History*, June 1975, pp. 428-457.

Elam, R., "The Effect of Lease Data on the Predictive Ability of Financial Ratios," *The Accounting Review*, (January 1975).

E.R. Johnson Associates, Inc., *A Study of the Chemical Toxicity of Low-Level Wastes Task 2 Summary Report Burial Ground Characteristics and Operating Procedures*, General Research Corporation, Santa Barbara, Calif., September 1978.

Fiedler, E.R., *Measures of Credit Risk and Experience*,, New York: National Bureau of Economic Research, 1971.

Foster D. Snell, Inc., *Potential for Capacity Creation in the Hazardous Waste Management Service Industry*, U.S. Environmental Protection Agency, Washington, D.C., 1976.

Fraine, H.G., and R.H. Mills, "Effect of Defaults and Credit Deterioration on Yields of Corporate Bonds," *The Journal of Finance*, 1961, pp. 423-434.

Frank, R.E., W.F. Massy and D.G. Morrison, "Bias in Multiple Discriminant Analysis," *Journal of Marketing Research*, 2 (August 1965), pp. 250-258.

Fred C. Hart Associates, *Preliminary Assessment of Cleanup Costs for National Hazardous Waste Problems*, U.S. Environmental Protection Agency, Washington D.C., 1979.

Grant, F.A., *Report on Phase 1 Work for Closure of Stringfellow Class I Hazardous Wastes Disposal Site Addendum No. 1*, James M. Montgomery Consulting Engineers, Pasadena, Calif., April 1980 (work conducted for the California State Water Resources Control Board).

Hawkins, D.F., *Corporate Financial Reporting: Text and Cases*, Homewood, Illinois: Richard D. Irwin, Inc., 1977.

Hickman, W.B., *Corporate Bond Quality and Investor Experience*, Princeton University Press, 1958.

Hickman, W.B., *Statistical Measures of Corporate Bond Financing Since 1900*, Princeton University Press, 1960.

Idaho Operations Office, Facts About Low-Level Radioactive Waste, U.S. Department of Energy, Washington, D.C., February 5, 1980.

Internal Revenue Service, Statistics of Income, Corporation Income Tax Returns, United States Government, various years.

International Research and Technology Corporation, An Analysis of Methods for Ensuring Continuity of Operation for Hazardous Waste Disposal Sites, U.S. Environmental Protection Agency, McLean, Va., April 1980a, IRT-21600.

International Research and Technology Corporation, Draft Guidance for Subpart H of the Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, U.S. Environmental Protection Agency, McLean, Va., August 1980b, IRT-21600.

International Research and Technology Corporation, Draft Guidance for Subpart G of the Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, U.S. Environmental Protection Agency, McLean, Va., August 1980c, IRT-21600.

International Research and Technology Corporation, A Feasibility Study of Constructing a Comprehensive Hazardous Spills Data Base, U.S. Environmental Protection Agency, McLean, Va., September 1980d, IRT-23200.

Johnson, C.G., "Ratio Analysis and the Prediction of Firm Failure," The Journal of Finance, (December 1970), pp. 1166-1172.

Kaplan, R.S. and G. Urwitz, "Statistical Models of Bond Ratings: A Methodological Inquiry," The Journal of Business, 52 (1979).

Klee, K.N., "All You Ever Wanted to Know About Cram Down Under the New Bankruptcy Code," 53 American Bankruptcy Law Journal, 133 (1979).

Klein, M.I., "The New Bankruptcy Code (Part 1)," 25 The Practical Lawyer, 35 (1979).

Klein, M.I., "The New Bankruptcy Code (Part 2) - Case Administration," 25 The Practical Lawyer, 73 (1979).

Lev, B., "The Prediction of Corporate Failure," Applications of Financial Statement Analysis, Prentice Hall, 1974, pp. 133-151.

Levin, R.B., "An Introduction to the Trustee's Avoiding Powers," 53 American Bankruptcy Law Journal, 173 (1979).

Levit, L.W., "Use and Disposition of Property Under Chapter 11 of the Bankruptcy Code: Some Practical Concerns," 53 American Bankruptcy Law Journal, 275 (1979).

Llewellyn, K.N., The Common Law Tradition: Deciding Appeals, 1960.

Lomax, K.S., "Business Failures: Another Example of the Analysis of Failure Data," American Statistical Association Journal, December 1954, pp. 847-852.

McWilliams, J.D., "Failure Models and Investment Management," Financial Crises: Institutions and Market in a Fragile Environment, Edward I. Altman and Arnold W. Sametz, ed., New York: John Wiley & Sons, Inc., 1977.

Moody's Industrial Manual, New York: Dun & Bradstreet Corporation, Volumes from 1960 through 1979.

National Low-Level Waste Management Program, Managing Low-Level Radioactive Wastes: A Proposed Approach, U.S. Department of Energy, Washington, D.C., August 1980, LLWMP-1.

"Note: Abandoning Bankruptcy Law's 'Identity of Interest' Exception," 78 Michigan Law Review, 273 (1978).

Office of Nuclear Material Safety and Safeguards, Regulation of Federal Radioactive Waste Activities, U.S. Nuclear Regulatory Commission, Washington, D.C., September 1979, NUREG-0527.

Oil and Special Materials Control Division, Damage and Threats Caused by Hazardous Material Sites, U.S. Environmental Protection Agency, Washington, D.C., January 1980, EPA 430/9-80-004.

Orr and K.N. Klee, "Secured Creditors Under the New Bankruptcy Code," 11 Uniform Commercial Code Law Journal, 312 (1979).

Putnam, Hayes, and Bartlett, Inc., Regulatory Impact Analysis of the Financial Assurance and Liability Insurance Regulations Under the Resource Conservation and Recovery Act of 1976, U.S. Environmental Protection Agency, Cambridge, Mass., 1981.

Rosenburg, R.J., "Intercorporate Guaranties and the Law of Fraudulent Conveyances: Lender Beware," 125 University of Pennsylvania Law Review, 235 (1976).

Ross, I., "Higher Stakes in the Bond Rating Game," Fortune, April 1976, p. 136.

SRI International, Directory of Chemical Producers, United States of America, Menlo Park, Calif., 1978.

Sanzo, R., Dynamics of the Credit Decision, Dun & Bradstreet Corporation, 1974.

Sherwood, H.C., How Corporate and Municipal Debt is Rated, New York: John Wiley & Sons, 1976.

Standard and Poor's Corporation, Standard and Poor's Ratings Guide, New York: McGraw Hill, Inc., 1979.

Tamari, M., "Financial Ratios as a Means of Forecasting Bankruptcy," Management International Review, 4 (1966), pp. 15-21.

Treister, G.M., and J.R. Trost, Resource Materials: Federal Bankruptcy Procedure Under the New Bankruptcy Rules, 1976.

Trost, J.R., "Business Reorganizations Under Chapter 11 of the New Bankruptcy Code," 34 The Business Lawyer, 1309 (1979).

Trost, J.R., et al., "The Discharge of Debts Under the New Bankruptcy Code," 25 The Practical Lawyer, 51 (1979).

Trost, J.R., G.M. Treister, L.S. Forman, K.N. Klee and R. Levin, Resources Materials: The New Federal Bankruptcy Code, 1979.

Troy, L., The Almanac of Business and Industrial Financial Ratios, Prentice Hall, 1979.

Walter, J.E., "Determination of Technical Solvency," The Journal of Business, 31 (January 1957), pp. 30-43.

Wein, H.J., "Environmental Regulation and the Bankruptcy Act," 17 Duquesne Law Review, 133 (1979).

Weintraub, B. and A.N. Resnick, "Allowance of Claims and Priorities Under the New Bankruptcy Code," 12 Uniform Commercial Code Law Journal, 1980.

GLOSSARY

Consolidated Income Statement and Balance Sheet Values

CA	Current Assets
CF	Cash Flow (NI + depreciation, depletion, and amortization)
CL	Current Liabilities
CURRAT	Current Ratio (CA ÷ CL)
EBIT	Earnings Before Interest and Taxes
NFA	Net Fixed Assets
NI	Net Income
NS	Net Sales
NW	Net Worth
NWK	Net Working Capital
PC	Balance sheet value of preferred and common stock
QA	Quick Assets (CA - Inventory)
QRAT	Quick Ratio (QA ÷ CL)
RE	Retained Earnings
TA	Total Assets
TL	Total Liabilities
VOPAD	Value of Property After Depreciation

Variables Employed in Financial Tests

A_{NB}	Percentage of a sample of non-bankrupt firms that pass a given test.
B	A subscript for M and E indicating the use of the best case assumption. If a test fails a firm at least two years prior to bankruptcy, there will still be sufficient time to ensure the funding of alternative mechanisms.

Reproduced from
best available copy.

GLOSSARY (Continued)

C	Percentage of a sample of bankrupt firms that fail a financial test with sufficient time remaining prior to bankruptcy to ensure that alternative financial mechanisms are funded.
D	The difference between the percentage of non-bankrupt firms passing a test and the equivalent percentage of bankrupt firms passing the same test. It is sometimes referred to as the discriminating power of the test.
E	The number of firms per 10,000 which pass a given financial test and will enter bankruptcy without funding alternative financial mechanisms.
H	Subscript used to indicate that a result refers to the holdout sample.
M	The percentage of a sample of bankrupt firms which would fail a given financial test with insufficient time remaining prior to bankruptcy to fund alternative financial mechanisms.
P	Subscript for M and E indicating the use of the most probable case assumption. For all firms that are first eliminated by a test three years prior to bankruptcy, there will still be sufficient time to ensure the funding of alternative financial mechanisms. One-half of the firms eliminated by a financial test two years prior to bankruptcy will fund alternative financial mechanisms prior to bankruptcy.
U	Subscript used to designate that a given value is based upon results using the utility sample.
W	Subscript for M and E indicating the use of the worst case assumption. If a test fails a firm at least three years prior to bankruptcy, there will be sufficient time to ensure the funding of alternative financial mechanisms.
x	Year of bankruptcy.
x-1	One year prior to bankruptcy.
x-2	Two years prior to bankruptcy.
x-3	Three years prior to bankruptcy.

GLOSSARY (Continued)

Variables Used in Computing Costs of Financial Assurance Mechanisms

A_{NB}	Percentage of viable firms that pass a given financial test
C	Closure costs
C_A	Private costs of auditor's special report/facility/year
C_F	Annualized private cost of auditor's special report/facility/year of facility life
C_L	Annualized private cost of fees for letter of credit/facility/year of facility life
C_{LP}	Fees for letter of credit during post-closure/facility/year
C_{LS}	Fees for letter of credit during facility life/facility/year
E	Number of firms per 10,000 that pass a given financial test that will go bankrupt without providing alternative financial assurance
h	Rate of inflation
i	Subscript for facility type (storage, surface impoundment, land disposal, incinerator)
L_L	Average loss from a letter of credit due to failure to adjust for inflation during facility life
N	Number of facilities owned by firms with $10 million in net worth and independently audited
P_C	Post-closure costs
PU_F	Direct public costs due to failure of firms using a financial test/facility
PU_L	Direct public costs due to failure of firms using a letter of credit/facility
r	Real interest rate
r_t	Real rate of return on trust fund

GLOSSARY (Concluded)

R_{CP}	Share of closure and post-closure costs not recovered from bankruptcy proceedings
t	Time
T	Length of the post-closure period
v	Rate at which firms which will later go bankrupt voluntarily shift from a letter of credit to a trust fund

RESOURCE CONSERVATION AND RECOVERY ACT
SUBTITLE C - HAZARDOUS WASTE MANAGEMENT

Section 3004 - Standards Applicable to Owners and Operators of
Hazardous Waste Treatment, Storage, and Disposal Facilities

40 CFR Parts 264 and 265, Subpart H
Financial Requirements

BACKGROUND DOCUMENT FOR THE FINANCIAL TEST & MUNICIPAL REVENUE TEST FINANCIAL ASSURANCE FOR CLOSURE AND POST-CLOSURE CARE

APPENDIX A

Evaluating the Effectiveness of Alternative Financial Tests

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF SOLID WASTE

November 30, 1981

A-1

TABLE OF CONTENTS

Page

I. GENERAL APPROACH I-1

- A. Introduction I-1
- B. Possible Elements of Financial Tests I-2
- C. Overview of the Methodology I-4
- D. Comparison to Alternative Methodological Approaches I-10

II. BASELINE FAILURE RATES AND DETERMINATION OF MULTIPLES II-1

- A. Baseline Failure Rates II-1
- B. Ability to Pay II-10

III. PROCEDURES USED IN SELECTING FIRM SAMPLES AND CANDIDATE FINANCIAL RATIOS III-1

- A. Sample Selection III-1
- B. Holdout Procedures III-6
- C. Selection of Financial Valuables to be Tested III-7
- D. Summary Financial Data for the Firm Samples III-14

IV. EVALUATION CRITERIA AND DEVELOPMENT OF RATIO TESTS IV-1

- A. Evaluation Criteria IV-2
- B. Development of Ratio Tests IV-7

V. TEST PERFORMANCE V-1

- A. Construction of the Performance Curves V-1
- B. Performance Curves for the Primary Sample V-3
- C. Performance with Respect to the Holdout Sample V-10
- D. Comparison to the Results of Other Tests V-26

VI. THE NEED FOR ALTERNATIVE TESTS FOR SPECIFIC INDUSTRIES VI-1

- A. Manufacturing Industries VI-2
- B. Electric Utilities VI-8
- C. Hazardous Waste Management Firms VI-13

VII. BOND RATINGS VII-1

VIII. RESULTS FOR ALL RATIO TESTS VIII-1

I. GENERAL ANALYTIC APPROACH

A. Introduction

The financial responsibility regulations under RCRA reproposed on May 19, 1980 included a financial test as an option for demonstrating a firm's capability to meet the costs of its facility closure and post-closure obligations. The proposed financial test for closure and post-closure care included elements designed to verify the current ability of a firm to pay such costs (net working capital equal to or greater than twice the estimated closure and/or post-closure costs: a minimum of $10 million in net worth), and a financial ratio designed to indicate the overall viability of a firm (a total liabilities to net worth ratio of less than 3 to 1). The financial test provision prompted many public comments. Several commenters expressed general reservations about the validity of the financial ratio used as an indicator of viability, or questioned the net working capital or net worth requirements, and suggested that an evaluation of financial test performance should be carried out to determine the effectiveness of financial tests. The Agency agreed with this proposal, and conducted a rigorous and comprehensive evaluation of over 300 alternative financial tests.

This Appendix describes the methodology employed in performing this evaluation and summarizes the results of the analysis which provide a set of "best" candidate tests. The results of special analyses, performed to determine the comparative effectiveness of one-year versus three-year eligibility requirements, and the need for specialized, industry-specific ratio tests, are also summarized in this Appendix. The "best" candidate tests were further evaluated against a set of algorithms designed to estimate the total direct public and private costs that would result from their implementation. The results of the cost calculations performed, and their implications for the final selection of a financial test, are discussed in Appendix B of this Background Document.

B. Possible Elements of Financial Tests

The ideal financial test would pass all firms capable of meeting their closure and post-closure obligations while failing all firms that would enter bankruptcy and not be able to meet those obligations. Unfortunately, no method of financial forecasting is capable of achieving this ideal. It is therefore useful to examine a range of possible financial tests. Some of these tests have the advantage of eliminating almost all firms that would be unable to meet their closure and post-closure obligations, but at the same time they also eliminate a large number of firms that could meet those obligations; other tests have the advantage of passing a much higher percentage of the firms that could meet those obligations but they eliminate fewer firms that could not meet their obligations.

A firm may be unable to meet its closure and post-closure obligations for a variety of reasons. In addition to the ordinary business misfortunes which may lead a firm into bankruptcy, a firm owning a hazardous waste treatment, storage or disposal facility (TSDF) might fail to meet those specific obligations as a result of unique events. For example, a firm that might otherwise not have entered bankruptcy may be forced into bankruptcy if its permit is suddenly withdrawn and it suddenly has to put up the necessary funds for closure and post-closure. A firm also might enter bankruptcy unexpectedly as a result of large cleanup or repair expenditures unique to a hazardous waste TSDF or of a large liability judgment.

This Appendix analyzes the performance of different possible financial tests, with respect to the percentage of firms which pass the tests and could meet their financial obligations, and the percentage of firms that could not meet their obligations but still pass a given test. The question of what test is to be preferred must then be determined by the relative costs associated with the different tests.

Three types of elements which might be used as criteria in financial tests are considered in this Appendix:

(1) Financial ratios: These are ratios of the financial variables found in the income statements or balance sheets of firms.

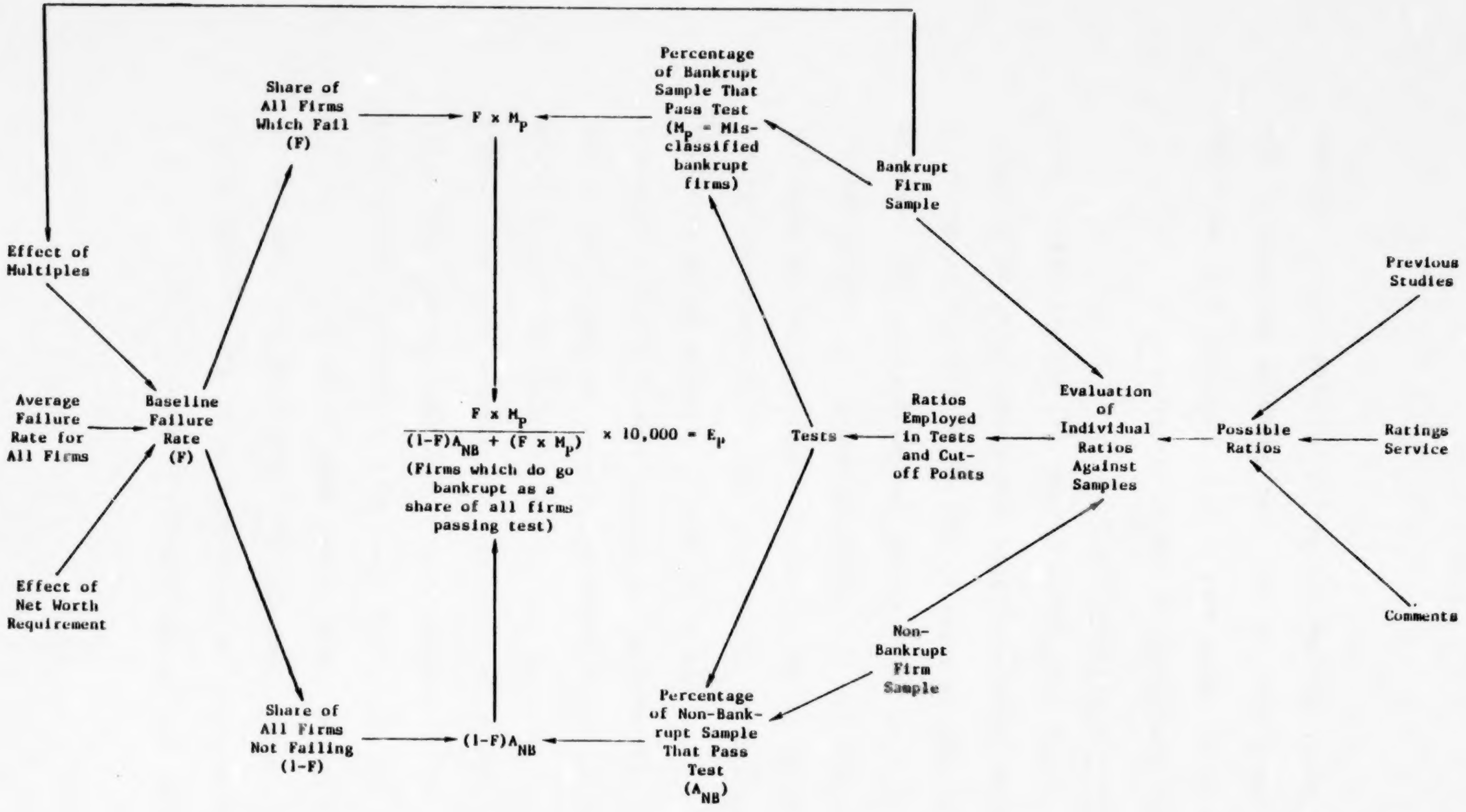
(2) Multiples: In this text, these are measures of unencumbered assets and/or liquidity as multiples of the specific financial obligation considered (closure and post-closure).

(3) Net worth: This is a requirement, independent of the multiple requirement described above, that a firm must have net worth above a specified level.

Each of these possible elements of financial tests has a potential role in limiting the number of firms that will fail to meet their financial obligations. By requiring firms to meet specific requirements with respect to their financial ratios in order to pass a financial test, it is possible to limit the percentage of firms which pass the financial test but which ultimately enter bankruptcy. Multiples serve to ensure that the financial obligation itself does not have so great an effect on the firm that it is a cause for bankruptcy. Without multiples as a part of the test, a small firm with excellent financial ratios might still be unable to meet its closure and post-closure obligations because of the large size of their obligations relative to the size of the firm itself. A minimum net worth requirement serves two purposes: (1) it has been found that the larger the firm the less likely it is to fail, and (2) significant size enables the firm to withstand unusual contingencies associated with the ownership of hazardous waste TSDFs. Financial ratios and minimum net worth requirements both can help to ensure that the failure rate of the firms which will pass the financial test is lower than the average failure rate for all firms. The multiple element of the test and the minimum net worth requirement help to ensure that the failure rate of the firms considered is not higher than that for firms in all industries, due to the unusual size of these special financial obligations relative to the size of the firm or due to contingencies associated with the ownership of hazardous waste TSDFs.

C. Overview of the Methodology

This Section, and Figure I-1, provide an overview of this Appendix by outlining the major steps of the methodology employed. Detailed discussions of the topics outlined in this section are then presented in the following sections of this Appendix. Figure I-1 illustrates in



Effect of Multiples
Average Failure Rate for All Firms
Effect of Net Worth Requirement
Baseline Failure Rate (F)
Share of All Firms Which Fail (F)
Share of All Firms Not Failing (1-F)
$F \times M_p$
$(1-F)A_{NB}$
$\frac{F \times M_p}{(1-F)A_{NB} + (F \times M_p)} \times 10{,}000 = E_p$
(Firms which do go bankrupt as a share of all firms passing test)
Percentage of Bankrupt Sample That Pass Test (M_p = Mis-classified bankrupt firms)
Percentage of Non-Bankrupt Sample That Pass Test (A_{NB})
Tests
Bankrupt Firm Sample
Non-Bankrupt Firm Sample
Ratios Employed in Tests and Cut-off Points
Evaluation of Individual Ratios Against Samples
Possible Ratios
Previous Studies
Ratings Service
Comments

FIGURE I-1

APPENDIX A METHODOLOGY

particular the steps which were used to derive the effectiveness measure (E_p) of any given test, that is, the most probable estimate of the number of firms per 10,000 which pass a given financial test but later fail without providing alternative financial assurance.

1. Determination of Baseline Failure Rate

In order to compare the effectiveness of various tests, with respect to the relative costs associated with these tests, it is necessary to determine the failure rates of the set of firms which may use a financial test as evidence of financial responsibility. The baseline failure rate (F) is derived by first determining the average failure rate for all firms based on the historical data, and then by adjusting this rate to account for the effect of a net worth requirement on the average failure rate for firms which may be eligible for a financial test. In addition to determining the failure rate of firms, a financial test includes a multiple requirement to provide assurance that at the time a firm ceases to pass the test it will continue to possess assets sufficient so that it is able to pay for closure and post-closure costs. Otherwise, it is possible that the attempt to pay these costs will be sufficient to force the firm into bankruptcy before these closure and post-closure costs have been fully paid. In the nomenclature adopted in this Appendix, the fraction of all firms considered which will go bankrupt is designated as F; the fraction of all firms considered which will not go bankrupt is equal to 1-F.

157

2. Selection of Financial Ratios

The financial ratios to be evaluated as candidate ratios for the financial test were selected from three sources: (1) comments received on the May 19, 1980 regulation; (2) surveys of opinions of bond rating services and credit analysts; and (3) existing literature on bankruptcy forecasting. The list of ratios assembled was extensive and varied widely in content and estimated effectiveness.

An initial set of financial ratios was chosen for further evaluation because they satisfied three basic conditions: (1) they produced significant predictive results in the prior literature; (2) they were frequently identified by bond rating services and credit analysts as key parameters; and (3) their values were readily available from corporate balance sheet data.

3. Sample Selection

In order to determine the effect of financial ratio tests, the Agency gathered samples of non-bankrupt and bankrupt firms. Non-bankrupt firms, also referred to as viable firms, are firms that did not enter bankruptcy within three years of the time period for which data were gathered. For bankrupt firms, financial data were gathered for three years prior to the time the firm entered bankruptcy. The sample of bankrupt firms was gathered from a variety of sources. The sample of non-bankrupt firms was gathered using the Industry Index of Moody's Industrial Manual to determine members of industrial categories that generate, treat, store, or dispose of hazardous waste on-site.

4. Evaluation of Financial Ratios

These ratios were first tested individually against the primary bankrupt and non-bankrupt firm samples, using a variety of pass-fail cutoff points for each ratio derived from the bankruptcy forecasting literature. A second set of financial ratios was then selected and tested against a sample of bankrupt and non-bankrupt firms which were consistently misclassified by the original ratios, to determine if there were additional financial ratios which would improve the predictive ability of a test.

5. Design of Financial Tests

The most promising ratios were combined to form 151 alternate multi-ratio tests. The ratios were combined in three ways: (1) two-ratio tests (firms must pass both elements of the test to pass); (2) three-ratio tests (firms must pass all three elements of the test to pass); and (3) three-ratio contingent tests (firms must pass two of three conditions to pass). The tests were then retested against the primary sample to derive for each test the percentage of bankrupt firms of the sample that pass the test and are therefore misclassified by the test (M_P) and the percentage of the non-bankrupt firms sampled which pass the test (A_{NB}).

6. Determining the Effectiveness Measure (E_P) for a Given Test

The effectiveness measure for any given test is calculated according to a two-step process (see Figure I-1 above.) First, the fraction of all firms which will go bankrupt (F) is multiplied by the percentage of the bankrupt firm sample that is misclassified by a given test (M_P), that is, pass the test but later enter bankruptcy. This provides the fraction of all firms considered that pass a particular test and later go bankrupt ($F \times M_P$). Similarly, the share of all firms that will not fail ($1-F$) is multiplied by the percentage of the non-bankrupt firm sample which pass the test (A_{NB}). This provides the fraction of firms that pass a given test and do not go bankrupt $(1-F)A_{NB}$.

Finally, the Agency uses $F \times M_P$ and $(1-F)A_{NB}$ to calculate what fraction of all firms that pass a given test are firms which will go bankrupt (in Figure I-1 this operation is represented by $F \times M_P$ divided by the total of all firms which pass the test $((1-F)A_{NB} + (F \times M_P))$. This fraction is then multiplied by 10,000 to yield the number of firms per 10,000 that pass a given financial test that will go bankrupt. This number (E_P) is the measure of effectiveness of a given test.

7. Use of Performance Curves to Select the Best Financial Test

As discussed above, a financial test has two basic performance measures: (1) the percentage of non-bankrupt firms that can pass the test (A_{NB}): and (2) the number of firms per 10,000 that pass the test that will later enter bankruptcy without providing alternative financial assurance (E_P). The Agency developed performance curves consisting of those tests which pass the maximum percentage of non-bankrupt firms for any given percentage of firms that pass the test and later enter bankruptcy. The Agency used these curves in the analysis described in Appendix B to evaluate the relative costs of alternative tests and to determine a best single financial test.

8. Comparison to Other Tests

The resulting performance curves for the tests developed in this study were then compared to the May 19, 1980 proposed financial tests and the results of other bankruptcy forecasting studies.

9. Industry-Specific Problems

Although a given financial test may serve quite well for most industries, it is possible that unique characteristics of a specific industry may cause a high percentage of the viable firms in that industry to fail a given test. In order to determine the importance of such problems, the Agency examined the financial characteristics of firms in various manufacturing industries likely to dispose of hazardous waste, electric utilities, and hazardous waste management firms.

10. The Role of Bond Ratings in a Financial Test

Section VII of this Appendix discusses the use of bond ratings as either a substitute for or a supplement to other elements of the financial tests considered elsewhere in this Appendix.

D. Comparison to Alternative Methodological Approaches

The methodology adopted by the Agency and outlined in Section I.C. is not the only methodology that might be employed to derive a set of financial tests. This Section considers three alternative approaches: (1) the use of functions of financial ratios rather than cutoff points for financial ratios; (2) the development of industry-specific financial tests rather than single tests for all industries; and (3) the use of population sampling instead of the sampling procedure employed in this analysis.

1. The Use of Functions of Financial Ratios

The approach used by the Agency was to examine a series of financial tests consisting of requirements that specific financial ratios be at certain levels. An alternative approach would be to design financial tests that consisted of linear or nonlinear functions of a set of financial ratios (for example, a linear function of financial ratios would be a test that required that $(a \times R_1) + (b \times R_2) + (c \times R_3) > d$, where a, b, c, and d are constants and R_1, R_2, and R_3 are ratios). Three methods have been proposed in the literature for developing financial tests that consist of functions of financial ratios.

One approach is to rely on expert judgment to decide which ratios should be included and what values should be associated with them (see Tamari, 1966). This approach has the disadvantage that there is no statistical method of determining whether the ratings or the financial ratios chosen have been appropriately determined.

A second approach that has been proposed is to develop a functional model of the factors that lead to business failure and to use this model to estimate the probabilities of business failure for any specific firm. Though theoretically elegant, this approach has only been attempted once in the literature reviewed for this study, and that attempt did not include any statistical validation of the model (Wilcox, 1971, as discussed in McWilliams, 1977).

The Agency decided not to develop a functional model for two reasons. First, the time available in which to carry out the study of a financial test option was relatively short and might not have allowed sufficient research and refinement of the model to produce useful results. Second, because the technique was untested in this application, the Agency was concerned that it might prove unsatisfactory, and that, if it were not effective, insufficient time would be available to carry out an alternative analysis.

The third approach, and that most commonly used in the bankruptcy forecasting literature, is that of multi-discriminant analysis. This is a statistical search technique for arriving at the best linear or non-linear function for a set of chosen financial ratios for discriminating between bankrupt and non-bankrupt firms. This is the most statistically sophisticated approach to the problem. The use of this approach was rejected in this study for two reasons: (1) a function of financial ratios would be more difficult to compute, more difficult to administer, and more difficult to check quickly than a simple set of ratio requirements; and (2) it has been pointed out several times in the literature on bankruptcy forecasting that multi-discriminant analysis has not yielded more accurate forecasts of bankruptcy than the simpler approach adopted here (Deakin, 1972 and McWilliams, 1977). A comparison of the results of the financial tests developed in this Appendix to financial tests developed in bankruptcy forecasting studies that employed multi-discriminant analysis is included in Section V.

2. Use of Industry-Specific Tests

A number of commenters suggested that the Agency adopt specific tests for different industries. The problem with this approach is the extreme difficulty of gathering sizable samples of bankrupt firms. An extensive search (described in Section III) for firms which had gone bankrupt and which had publicly available financial statements yielded a total of only 95 firms, of which many were retail firms and none were electric utilities. To further subdivide this sample into, for example, two-digit SIC codes would result in samples of bankrupt firms too small to be significant. Thus, while industry-specific tests might be theoretically desirable, they cannot be developed from the data currently available. A review of the bankruptcy forecasting literature found only one study which had developed industry-specific tests (Altman, 1973). This study was of the extremely bankruptcy-prone railroad industry, and still had to use bankruptcies over a period of 50 years in order to develop an adequate sample size.

3. Use of Population Sampling

As outlined in Section I.C., the performance of a financial test was developed in two steps: first, the development of a baseline failure rate, and second, the determination of how this baseline failure rate was reduced by the performance of a specific test. The performance of each test was measured against the samples of bankrupt and non-bankrupt firms. An alternative procedure would be to gather relevent data for a large population of firms, determine which ones later entered bankruptcy and which ones did not, and then examine each test against this entire sample for its ability to forecast bankruptcy. The problem with this approach is that bankruptcy is a relatively rare event. The average business failure rate in the post-war period has been approximately 44 per 10,000 firms per year. This implies that in order to

161

obtain a sample of bankrupt firms as large as that used in this study, it would have been necessary to obtain data on a total of 15,000 firms. Such an effort would have been beyond the scope of this study, and has not been attempted in any previous study of bankruptcy forecasting. The structured sample employed in the study should provide, however, approximately equivalent results.

II. BASELINE FAILURE RATES AND DETERMINATION OF MULTIPLES

A. Baseline Failure Rates

This Section explains how the Agency determined a baseline failure rate applicable to large firms from the existing data on failure rates by size of firm. For the purposes of this study, "large firms" were considered to be firms with over $10 million in net worth.

Table II-1 is a compilation by Dun & Bradstreet of historical failure rates per 10,000 firms, incorporating all sizes of firms. As shown in the Table, the arithmetic mean for the period 1950-1978 is 44 business failures per year per 10,000 firms. This is probably too high a baseline failure rate for the kinds of large firms considered in this study. Greater assets and net worth reduce the probability of corporate failure. The failure rates shown in the Table for all firms thus may overstate the rate of failure for large firms. Altman suggests a reason for this phenomenon:

> [M]any of these companies are not permitted to fail. Except in the event of fraud, or where the failing company is simply too large, we rarely observe in the decades before 1970 firms of over $25 million in assets actually going bankrupt. In many cases, the financially troubled firms can expect to be wooed by a highly liquid or managerially rich firm, usually resulting in a merger absorption before insolvency in a bankruptcy sense occurs. (Altman, 1971)

During the period from 1969 to 1974, for example, Douglas Aircraft, Ling-Temco-Vought, Lockheed Aircraft, and Mohawk Data Sciences came very close to failing, but failure was prevented by government intervention or private sector efforts (Altman et al., 1977).

Precise quantitative data on failure rates by size of firm are not available. Dun & Bradstreet, which maintains the only extensive failure

TABLE II-1

ANNUAL BUSINESS FAILURE PER 10,000 FIRMS

Years	Arithmetic Mean	Maximum Year	Number of Years Over 60
1970-78	36	44	0
1960-69	52	64	2
1950-59	42	56	0
1940-49	26	63	1
1930-39	86	154	8
1950-1978	44	64	2
1930-1978	49	154	11

SOURCE: Derivation from Dun & Bradstreet (1979).

rate data now published, does not regularly provide data on failure rates by size of assets, sales, or net worth. Although a good deal of indirect evidence suggests that larger firms have substantially lower failure rates, a combination or comparison of the different data bases is difficult. The estimate in this study of the baseline failure rate for large firms was derived from the following sources:

(1) Dun & Bradstreet publications on the relationship between credit ratings and failure rates;

(2) Quantitative data from Altman (1971) combined with IRS statistics on the number of corporations above a given size; and

(3) A study by Richard C. Edwards on long-term failure rates for very large firms.

1. Failure Rates by Credit Ratings and Firm Size

Dun & Bradstreet credit ratings are composed of two elements -- size and creditworthiness. Size is defined as the companies' tangible net worth. Creditworthiness is rated from 1 (high) to 4 (limited). Table II-2 provides the key to the ratings classifications.

A study of the relationship between business failures and these Dun & Bradstreet credit ratings has been published. The results of the study are presented in Table II-3. Because the size categories are approximately equal to the tangible net worth of the firm, two conclusions can be drawn from the results in this Table. First, firms in the top two categories for financial strength (representing firms of above $50 million in tangible net worth and firms of between $10 and $50

TABLE II-2

KEY TO RATINGS

Estimated Financial Strength				Composite Credit Appraisal			
				High	Good	Fair	Limited
5A	Over		$50,000,000	1	2	3	4
4A	$10,000,000	to	50,000,000	1	2	3	4
3A	1,000,000	to	10,000,000	1	2	3	4
2A	750,000	to	1,000,000	1	2	3	4
1A	500,000	to	750,000	1	2	3	4
BA	300,000	to	500,000	1	2	3	4
BB	200,000	to	300,000	1	2	3	4
CB	125,000	to	200,000	1	2	3	4
CC	75,000	to	125,000	1	2	3	4
DC	50,000	to	75,000	1	2	3	4
DD	35,000	to	50,000	1	2	3	4
EE	20,000	to	35,000	1	2	3	4
FF	10,000	to	20,000	1	2	3	4
GG	5,000	to	10,000	1	2	3	4
HH	Up	to	5,000	1	2	3	4

SOURCE: Dun & Bradstreet.

TABLE II-3

RELATIONSHIP OF D&B CREDIT RATINGS WITH BUSINESS FAILURES

Rating Category	Percent of Failures Rated High		Percent of Failures Rated Good		Percent of Failures Rated Fair		Percent of Failures Rated Limited	
	1971	1972	1971	1972	1971	1972	1971	1972
5A[1]	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4A[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3A[3]	0.00	0.01	0.00	0.02	0.33	0.50	0.00	0.00
2A	0.00	0.00	0.09	0.04	0.37	0.23	0.00	0.00
1A	0.00	0.00	0.00	0.00	0.36	0.25	4.00	0.00
BA	0.00	0.00	0.05	0.03	0.30	0.15	0.31	0.00
BB	0.00	0.00	0.02	0.02	0.35	0.18	1.50	0.00
CB	0.00	0.01	0.04	0.05	0.31	0.28	1.17	1.02
CC	0.00	0.01	0.05	0.04	0.39	0.36	1.65	1.48
DC	0.01	0.00	0.05	0.05	0.37	0.43	1.46	2.46
DD	0.01	0.02	0.06	0.06	0.41	0.52	2.05	2.04
EE	0.01	0.00	0.08	0.08	0.46	0.52	1.89	0.00
FF	0.00	0.02	0.08	0.09	0.46	0.49	1.70	1.70
GG	0.05	0.06	0.08	0.08	0.43	3.63	1.33	1.40
HH	0.00	0.00	0.07	0.06	0.21	3.50	0.50	3.49

SUMMARY

Percent Failures to Listings Rated

	1971	1972
High	0.004%	0.007%
Good	0.07	0.06
Fair	0.40	0.40
Limited	1.42	1.51
Numeral	0.06	0.07
Blank	0.75	0.64
Total Failures per 10,000 listings	42	38

---

[1] Category represents firms with over $50 million in tangible net worth.

[2] Represents firms with between $10 and $50 million in tangible net worth.

[3] Represents firms with between $1 and $10 million in tangible net worth.

SOURCE: Sanzo (1974).

million in net worth) have substantially fewer failures for every credit appraisal rating than do firms in lower categories, including firms with from $1 to $10 million in net worth. The Table shows that the percent of failures is .00 percent for the top two credit ratings. However, the failure rate for firms in the financial strength category of 3A or lower, i.e., firms with less than $10 million in tangible net worth, increases, especially for those firms with a "fair" credit rating. The "limited" rating is given to firms for which insufficient data are available to provide a more specific rating. As the Table shows, the majority of firms with a "limited" rating are smaller firms in the lower financial strength categories.

One problem in using these data is that when very large firms, such as W. T. Grant, are believed to be approaching failure, they are not given a "limited" rating but rather are given a special rating indicated by a double hyphen. This means that if Dun & Bradstreet thinks that failure is a possibility for a very large firm, it is not rated at all. Nevertheless, this tends to be a relatively small category (Backer and Gosman, 1978).

Table II-3 also shows that Dun & Bradstreet has greater difficulty accurately rating small firms than large firms. For every credit rating, there are significantly more failures in the small-firm categories than in the respective large-firm categories.

2. Quantitative Data from Altman Analysis and IRS Statistics

In 1970, 12 firms of over $10 million in assets filed for bankruptcy (Altman 1971). At that time, there were 23,300 corporations of over $10 million in assets (U.S. Internal Revenue Service, Statistics of Income, Corporate Income Tax Returns). Thus, the implied bankruptcy rate in 1970 for firms of over $10 million in assets is approximately 5 per 10,000. Given that the failure rate for all firms is over 44 per 10,000, this implies that the failure rate for firms of over $10 million in assets is only about 11 percent of that reported for all firms.

3. Long-Term Failure Rates for Very Large Firms: Data from Edwards Analysis

In a study conducted in 1975, Richard C. Edwards traced the corporate development of 225 very large firms from the years 1919 to 1969. Very large firms in the Edwards study were defined as firms with over $50 million (in 1967 dollars) in assets in the year 1919. This is approximately equivalent to $100 million in assets in 1980 dollars. The purpose of Edwards' study was to determine the extent to which large size alone might effectively prevent the possibility of business failure. Table II-4 shows the results of this study. For comparison, the average failure rate for all firms for this period, as derived from Dun & Bradstreet data, is 61 firms per 10,000. As is shown in the Table, the failure rate for large firms as a percentage of the failure rate for all firms varies from 18 to 32 percent, depending on which class of firms is examined. This wide variance is largely due to the inclusion in the sample of 15 urban transit firms, virtually all of which failed during the 1920's and 1930's.

4. Summary of Failure Rate Data Bases and Conclusions

Table II-5 summarizes the results discussed above. These results strongly suggest significantly lower failure rates for larger firms, but

TABLE II-4

FAILURE RATES OF VERY LARGE FIRMS

Class of Firm	Number of Firms[1/]	Number of Failures[1/]	Implied Annual Rate Per 10,000 Firms[2/]	Implied Failure Rate as a Percentage of Dun & Bradstreet Failure Rate For all Firms (61/10,000)[3/]
Manufacturing	110	8	15	24
All Firms Except Urban Transit	210	11	11	18
All Large Firms	225	22	19.5	32

[1/] Number of firms and failures are from Edwards (1975).

[2/] Implied failure rate calculated as:

$$\left(1 - \frac{\text{number of failures}}{\text{number of firms}}\right)^{1/50}$$

[3/] Derivation from Dun & Bradstreet data.

SOURCE: Derivation from Edwards, 1975.

TABLE II-5

SUMMARY OF EVIDENCE ON FIRM FAILURE RATES BY SIZE OF NET WORTH

Size Category	Failure Rate as a Percentage of Failure Rate for All Firms
+$10 Million in Net Worth with a D&B Fair Credit Rating (1971-1972)	1
+$25 Million in Net Worth (1970)	11
+$100 Million in Assets (1919-1969)	18-32

a precise estimate is impossible to determine given the quality of the data bases. For example, the estimate of a 1 percent failure rate for firms with over $10 million in net worth as a percentage of the failure rate for all firms based on firms with a Dun & Bradstreet "fair" credit rating is probably an underestimate. Since Dun & Bradstreet provides no data on the distribution of firms by size, it is impossible to determine from Table II-3 if the entries of .00 percent, which Dun and Bradstreet states may be any percentage less than or equal to .004, represent a significant number of firms. Further uncertainty arises from the fact that large firms that are expected to fail are not rated at all.

Although it is impossible to derive a precise failure rate for large firms from the data available, all of the data suggest that the failure rate is at least 50 percent lower than the failure rate for all firms. The Agency concluded that an estimated baseline failure rate of 22 per 10,000 for firms with over $10 million in net worth was reasonable, assuming that the failure rate for large firms would be at least 50 percent lower than the estimated failure rate of 44 per 10,000 for all firms. Considering the quality of the data, however, even smaller failure rates than 22 per 10,000 are possible.

B. Ability to Pay

The fact that a firm has not actually entered bankruptcy does not ensure that it has adequate funds available to meet financial responsibility obligations. This Section therefore describes how the Agency determined if adequate funds would be available to those financially weakest firms which pass a financial test to meet their financial responsibility obligations. If a non-bankrupt firm does not have adequate funds, then such obligations may themselves be a cause of bankruptcy. This Section also describes how the Agency determined what additional requirements are necessary to ensure that such obligations can be met without increasing the failure rate. These determinations were made primarily through the examination of the characteristics of several firms that would pass many possible financial tests and enter bankruptcy within three years of passing the test. Such firms were the financially weakest of all firms that could pass financial tests.

1. Availability of Funds

To analyze the adequacy of the funds available to financially weak firms immediately prior to bankruptcy, the Agency examined a sample of 12 bankrupt firms. These firms passed many ratio tests (see Sections III and IV) three years prior to bankruptcy, and tests which were stringent enough to eliminate them also eliminated a large percentage of viable firms. The fact that several of the 12 firms also passed a number of tests two years prior to bankruptcy indicates that their financial status deteriorated very rapidly. They therefore represent the type of firms most likely to fail a financial test only at the point where they lack sufficient funds to establish an alternate form of financial assurance. The Agency examined financial data for these firms to determine whether they would have been able to meet financial responsibility obligations at the time they were eliminated by a financial test.

Table II-6 shows, for the 12 firms, the changes in net working capital, net worth and quick assets occurring over the three years preceding bankruptcy. As can be seen from this Table, even if these firms did not fail a financial test until two years prior to bankruptcy, all of the firms still would have had positive net worth and some quick assets. In fact, the quick assets of most of these firms increased between the third and second year prior to bankruptcy. Therefore, if these firms had failed a financial test two years prior to bankruptcy, they would have had significant amounts of cash and other liquid assets. Current assets would have exceeded current liabilities for two-thirds of the firms, and total assets would have exceeded total liabilities for 11 of the 12 firms.

If the establishment of an alternative means of financial assurance for these firms were delayed by, for example, legal proceedings, Table II-6 shows that 66 percent of the firms (8 out of 12) still would have had positive net working capital one year prior to bankruptcy. All except one firm would have had positive net worth, and all would have had significant quick assets. Therefore, with a delay up to one year prior to bankruptcy, 66 percent of the firms would have maintained adequate cash and net working capital to pay at least some of their obligations. Furthermore, negative net working capital alone does not necessarily imply that a firm cannot pay any of its debts. A conservative conclusion would be that if legal proceedings normally took one year or less, at least 50 percent of the firms that pass the test up to two years prior to bankruptcy would still have sufficient funds to establish an alternative form of financial assurance.

TABLE II-6

CHANGES IN KEY FINANCIAL PARAMETERS FOR 12 BANKRUPT FIRMS LIKELY TO BE MISCLASSIFIED BY A FINANCIAL TEST

Company Name	Percent of Decline From 3 Yrs To 2 Yrs Prior to Bankruptcy			Percent of Decline From 2 Yrs to 1 Yr Prior to Bankruptcy			Percent of Decline From 3 Yrs to 1 Yr Prior to Bankruptcy		
	NWK	NW	QA	NWK	NW	QA	NWK	NW	QA
Waltham	+[1]	+	+	-[2]	92.8	35.5	-	90.2	7.3
Bowmar	+	+	+	+	76.4	12.9	+	50.7	+
Polarad	60.9	41.9	+	+	16.7	26.1	34.8	51.6	15.0
Beck	+	+	+	+	+	+	+	+	+
Unishops	+	11.5	+	-	-	+	-	-	-
Uniservices	+	+	+	66.7	48.5	27.3	40.0	32.0	20.0
Remco	39.7	9.0	+	75.6	84.0	12.3	85.3	85.4	6.5
Maule Industries	-	+	+	-	11.6	50.5	-	+	38.1
M.H. Fishman	4.9	5.7	13.6	2.6	4.6	+	7.4	10.0	+
National Video	NA	+	51.6	21.1	21.2	26.9	21.1	18.9	64.6
Dolly Madison	+	+	+	83.8	5.8	+	75.7	+	+
King Resources	89.5	+	NA	-	65.7	NA	-	38.6	NA

---

[1] A plus sign indicates that there was an increase in value rather than a decline.

[2] A negative sign indicates that there was a negative value so calculating the percentage decline is meaningless.

NA: Not available

To test this hypothesis, the Agency examined the net working capital and net worth of the entire sample of 66 bankrupt firms. Table II-7 shows that over 88 percent of all of these bankrupt firms had positive net working capital and positive net worth three years prior to bankruptcy. In fact, even one year prior to bankruptcy, 89 percent still had positive net worth and 72 percent still had positive net working capital.

2. Multiple Requirements

Adequate funds will only be available if the net working capital, net worth and quick assets of a firm are large enough to cover its required financial responsibility obligation, without the expenditures themselves causing bankruptcy. Financial test criteria which require net working capital and net worth to be equal to some multiple of the costs of closure and post-closure would help ensure the availability of adequate funds. Table II-6, which gives the rates of deterioration of net working capital, net worth and quick assets for the 12 bankrupt firms discussed above, shows that the quick assets for most of these firms deteriorated relatively slowly. This suggests that a financial test requiring minimum levels of quick assets will not necessarily ensure that adequate funds are available when needed. The percentage declines in net working capital and net worth are significant, and suggest that a test should require that net working capital and net worth be multiples of closure and post-closure costs.

Under normal circumstances, a firm with net working capital equal to twice the estimated closure and post-closure costs would be able to

TABLE II-7

GENERAL ABILITY TO PAY CHARACTERISTICS OF FIRMS APPROACHING BANKRUPTCY

	Years Prior to Bankruptcy		
	x-3	x-2	x-1
Percentage of All Bankrupt Firms with Positive Net Working Capital	88	79	72
Percentage of All Bankrupt Firms With Positive Net Worth	97	97	89

pay these costs without threatening its continued viability. Inspection of the financial data of bankrupt firms, however, indicates that net working capital may often decline precipitously as bankruptcy nears. Furthermore, firms approaching bankruptcy may frequently experience negative cash flow, which will place additional burdens on available net working capital. Nine of the 12 firms sampled, for example, had negative cash flows in the year prior to bankruptcy. Therefore, a financial test should require that net working capital be a multiple of closure and post-closure costs, in order to provide the Agency with a reasonable probability that a firm will have resources available for the establishment of an alternative form of financial assurance.

The Agency determined the appropriate multiple by assuming that if a firm met this multiple requirement three years prior to bankruptcy, then it would still have sufficient funds for its financial responsibility obligations one year prior to bankruptcy. This requirement can be derived in the following way:

(1) $V_3 \geq M \times FR$

(2) $V_1 \geq FR$,

where V_3 is the value of net worth or net working capital three years prior to bankruptcy, V_1 is the value of net worth or net working capital one year prior to bankruptcy, M is the value of the multiple, and FR is the value of the financial responsibility obligation (closure costs, post-closure costs, and/or liability requirements). Solving for M yields:

(3) $\frac{V_3}{V_1} \geq M$

This multiple has been calculated for each of the 12 firms in the sample discussed above, with the results shown in Table II-8. The average value of the multiple for the firms that experienced a decline in net working capital but still had positive net working capital is 2.8. That is, if net working capital had been equal to 2.8 times the cost of financial responsibility obligations three years prior to bankruptcy, then adequate funds would still have been available one year prior to bankruptcy (i.e., after the firm's net working capital had deteriorated). The average multiple for net worth for firms which had positive net worth remaining one year prior to bankruptcy was 3.3.

These multiples only ensure that these firms would have had net working capital and net worth exactly equal to their financial responsibility obligations. As noted above, this provides no margin of safety after the financial responsibility obligations have been met. If both of the above multiples are rounded to 3, and then multiplied by 2 to provide a reasonable margin of safety and to ensure that the firm has some funds remaining to cover other liabilities which may not be recorded on the balance sheet, then multiples of 6 result. These multiples provide a margin of safety to ensure that the failure rates are not greater than those estimated in the previous Section (22 per 10,000), and to ensure that adequate funds are available even in the event of lengthy legal proceedings to obtain the funds.

TABLE II-8

MULTIPLES OF FINANCIAL PARAMETERS NECESSARY TO INSURE AGAINST FIRM DETERIORATION

Company Name	Net Working Capital	Net Worth	Quick Assets
Waltham	-[1]	10.2	1.1
Bowmar	+[2]	2.0	+
Polarad	1.5	2.1	1.2
Beck	+	+	+
Unishops	-	-	+
Uniservices	1.7	1.5	1.3
Remco	6.8	6.8	1.1
Maule Industries	-	+	1.6
M. H. Fishman	1.1	1.1	+
National Video	1.3	1.2	2.8
Dolly Madison	4.1	+	+
King Resources	-	1.6	NA
Average Multiple	2.8	3.3	1.5
No. of firms that decline in value	10/12	9/12	6/12
% of firms that decline in value	83%	75%	50%

[1] Negative sign indicates negative value

[2] A plus sign indicates an increase in value from three years to one year prior to bankruptcy

NA: Not available

III. PROCEDURES USED IN SELECTING FIRM SAMPLES AND CANDIDATE FINANCIAL RATIOS

A. Sample Selection

The Agency assembled an initial sample of 95 firms that filed under either Chapter 10 or Chapter 11 of the Federal Bankruptcy Act between 1966 and 1979. These firms were identified in two ways. Previous articles on bankruptcy forecasting by Altman, Haldeman and Narayanan (1977) and Elam (1975) listed the bankrupt entities investigated in each study. The Agency included these firms in its sample if financial data for the three-year period preceding bankruptcy could be located. Additional bankrupt firms were identified through a two-step process. The Agency compiled a list of all companies that had ceased to be listed in Moody's Industrial Manual between 1968 and 1978 (excluding all firms specifically identified as having undergone name changes, mergers, etc.). The fate of these firms was then determined by consulting the company section of Funk and Scott's Annual Periodical Index. Actual bankruptcy filing dates for firms in this sample were identified either from Funk and Scott or the Bankruptcy heading of the annual Wall Street Journal Index.

The Agency then compiled financial data for each sampled firm for the three years immediately prior to bankruptcy. These data were collected primarily from Moody's Industrial Manual and supplemented when necessary by the company Form 10-K reports submitted annually to the Securities and Exchange Commission. As a result of serious data gaps, three firms were dropped from the original list of 95. Still later, the Agency decided to exclude all firms primarily engaged in wholesale, retail and/or transportation service activities from the sample, since these are not likely to be TSDFs, further reducing the final sample size to 66 firms.

The average net worth of the 66 bankrupt firms sampled (in the third year prior to bankruptcy) was $14.5 million; only one non-retail firm had a net worth greater than $100 million. The average asset size of the bankrupt firm sample was $46.5 million. Thus, as shown in Table III-1, the Agency obtained a sample with a higher average asset size than the samples in almost all previous studies (Beaver, 1968; Altman, 1968; Altman, et al. 1977; Deakin, 1972).

The Agency then assembled a sample of 190 non-bankrupt firms identified by the industry index of Moody's Industrial Manual as members of industrial categories that generate and dispose of large quantities of hazardous waste on-site (e.g., primary metals, petroleum refining, chemical and plastics manufacturing, textiles). Data were collected from Moody's, for these firms for the three-year period 1973-1975. The recession year of 1975 was deliberately chosen to evaluate the effects of business cycle fluctuations on financial ratio performance. Twelve of these firms were later eliminated because they were primarily engaged in wholesale, retail, or transportation service activities.

Of the 178 firms in the final non-bankrupt sample, slightly more than half had net worth (in 1973) of less than $100 million. For the smaller firms, the averages for net worth and asset size were $33.6 million and $69.8 million, respectively; for the larger firms, $519.5 and $985.7 million, respectively.

TABLE III-1

AVERAGE ASSET SIZE OF BANKRUPT FIRM SAMPLES

(In Millions of Dollars)

Sample	Number of Firms	Average Asset Size
EPA	66	46.5
Altman, et al. 1977	53	96.0[1]
Deakin, 1972	79	20.0
Altman, 1968	31	6.4
Beaver, 1966	79	6.3

[1] Five non-bankrupt firms (Douglas Aircraft, Ling-Tempco-Vought, Lockheed Aircraft, Memorex Corp., and Mohawk Data Sciences) with very large assets were included in the bankrupt firm sample because the firms remained non-bankrupt only due to extraordinary external support.

Several bankruptcy forecasting studies have utilized matched bankrupt and non-bankrupt firm samples. Each firm in the bankrupt sample had a counterpart in the non-bankrupt sample that had a relatively equal asset size and belonged to the same industry category. After careful deliberation, the Agency decided that use of such a matched sample would not satisfy the needs of this evaluation. Although the sample of bankrupt firms assembled for this study is one of the most comprehensive ever developed, it contains very few firms with greater than $50 million in net worth, because very few firms of this size fail. Several of the most highly publicized business failures of the last decade (W.T. Grant, Penn Central, United Merchants & Manufacturers) were excluded from the sample because those firms were primarily involved in activities other than manufacturing, and this reduced still further the number of large firms. As a consequence, matched sample techniques would not have provided information about the effectiveness of the various ratio tests in accurately classifying the large, viable firms most likely to make use of a financial test provision. The Agency did add a representative sample of large firms to the non-bankrupt group, in order to verify whether test options were effective over all size ranges.

The Agency also chose not to undertake a one-for-one matching of sampled firms by industrial category. In order to assemble a sample of bankrupt firms of sufficient size to provide statistically significant results, it was necessary to include a substantial number of firms involved in manufacturing activities not commonly associated with hazardous waste generation (such as bakeries). The Agency determined that the improvements in classification accuracy that would result from evaluating test alternatives against a set of firms likely to seek to use a financial test greatly outweighed any potential inaccuracies engendered by the use of an unmatched sample. To verify this conclusion, the Agency performed a supplementary comparison of industry financial ratio averages, as described in Section VI of this Appendix.

Many commenters on the May 19, 1980 regulation suggested that electric utilities and hazardous waste management firms possessed unique financial characteristics and should be provided with a separate financial test. To test these premises, special samples of 26 utilities and two representative large hazardous waste management firms were examined. These results are described in Section VI.

The fundamental limitation of this analysis with respect to the samples of firms, particularly the non-bankrupt firm sample, is uncertainty with respect to how well they match the financial characteristics of firms that own or operate TSDFs. In the absence of information about the population which the samples are to represent, there is no real way to check for biases created by the methods used to assemble the samples.

The firms in the non-bankrupt sample were not randomly selected from firms listed in Moody's. Judgment was applied to ensure that firms were chosen from the specific industries considered most likely to own or operate TSDFs and to ensure a greater representation of smaller firms than a random sample from Moody's would have produced. Because the sample was not randomly drawn, the possibility exists that the judgment employed may have inadvertently resulted in the selection of firms exhibiting unusually strong or weak financial characteristics. To check this possibility, the Agency compared the mean values of the non-bankrupt firm sample to those of other samples used in past studies of this kind. (This full comparison is given in Section V.D.2.) Where data on comparable ratios were available, the average values of ratios for the non-bankrupt sample in this study was either very similar to that for other studies (within 10 to 20 percent), or fell between the values given by other studies (average values for cash flow to total liabilities vary widely among samples in other studies). As a further check for possible bias, the distribution of specific ratios for the non-bankrupt firm sample was compared to the population of all firms in specific industries reportd in the Expanded Coverage section of the 1980 Moody's Industrial Manual (Volume I) (see Section VI.A of this Appendix). This comparison showed that most industries had from 5 to 10 percent more firms meeting a given ratio cutoff point than are found in the non-bankrupt firm sample for 1975. This would indicate that either due to changes in industry financial performance between 1975 and 1980, or due to differences between the two samples, the percentage of viable firms passing a test could be higher than that reported in this study.

B. Holdout Procedures

In an analysis in which numerous combinations of financial ratios are tested on a randomly drawn set of firms, it is important to avoid the possibility of search bias. If many combinations of financial data are tested, the test which is evaluated as the most effective may attain this result because it is peculiarly sensitive to the precise characteristics of the sample being analyzed. To ensure that such search biases did not influence the final conclusions of this analysis, the Agency created a "holdout" sample comprised of firms randomly selected by a computer from the original bankrupt and non-bankrupt samples (Frank, Massy, and Morrison, 1965). The testing procedure was then conducted in two phases. All tests were evaluated initially against the 136 non-bankrupt and 42 bankrupt firms which remained in the "primary" sample. Those tests which provided the best results were then validated against the 42 non-bankrupt and 24 bankrupt firms in the holdout sample.

C. Selection of Financial Variables to be Tested

In selecting the financial ratios to be tested in this analysis, the Agency consulted a broad spectrum of opinion, placing particular weight on available empirical results. Candidate financial ratios were drawn from three principal sources: the comments received on the May 19, 1980 proposed regulation, the surveyed opinions of bond rating service personnel and credit analysts, and the existing literature on bankruptcy forecasting. The recommendations from each of these sources are summarized below.

1. Recommendations of Commenters

Several commenters proposed other financial ratios as better indicators of firm viability than the total liabilities/net worth ratio. Alternative ratios most frequently mentioned involved cash flow, net income, net worth, total liabilities, debt and equity. Other measures identified were the quick ratio, estimates of return on investment, total fixed assets, retained earnings, and net sales. In addition, a number of commenters proposed that qualitative measures of a firm's financial position, such as corporate bond ratings or an affirmative auditor's statement in the company's annual Form 10-K report, be used to supplement or to substitute for a ratio test. None of these commenters provided quantitative data on the expected classification accuracy of their preferred alternatives, and only a few suggested what an appropriate pass-fail cutoff point would be for the ratios proposed. Consequently, these comments were used to identify candidate ratios, but did not play a significant role in the critical assessment process.

2. Bond Rating and Credit Analysts

Detailed interviews with senior financial analysts from the bond rating agencies, leading investment banking firms, and a number of major urban banks conducted for a study (Backer and Gosman, 1978) for the National Association of Accountants identified the financial ratios those analysts considered most important to their credit decisions. Those ratios are listed in Table III-2. The same authors also conducted an empirical study of the rate of deterioration in financial variables for 57 firms whose bond, trade credit, or bank loan ratings had been downgraded. This analysis indicated that the ratios of cash flow[1]/total debt, total debt/total net worth, and return on sales showed the most significant deterioration in the two years prior to downgrading, and hence had the highest correlation with actual credit actions. The

---

[1] Cash flow in this Appendix refers to the sum of net income, depreciation, depletion, and amortization.

TABLE III-2

FINANCIAL RATIOS CONSIDERED MOST SIGNIFICANT BY CREDIT ANALYSTS
(based on interview results)

	Short-Term		Intermediate Term	Long-Term
Financial Ratios	Bank Loans Seasonal	Trade Credit	Bank Loans Term	Bonds
Accounts Receivable Turnover	X			
Cash Flow to Total Debt*			X	X
Current Liabilities to Tangible Net Worth		X		
Current Ratio	X	X		
Fixed-Charge Coverage				X
Inventory to Working Capital		X		
Inventory Turnover	X			
Long-Term Debt to Working Capital		X		
Quick Ratio	X	X		
Return on Sales			X	
Total Debt to Tangible Net Worth*	X	X	X	X
Working Capital to Sales			X	

Source: Backer & Gosman (1978).

*We have substituted the word "debt" for "liabilities" because the great majority of interviewees indicated that they exclude Deferred Taxes and Minority Interest from liabilities, thereby approximating debt.

analysis also revealed that many other ratios not identified in the interview process showed much greater deterioration for the sampled firms than the ratios listed in Table III-2.

3. Results of Prior Bankruptcy Forecasting Studies

The Agency carefully reviewed the existing literature on bankruptcy forecasting and identified a large array of financial ratios that have previously been analyzed for their predictive abilities. These ratios can generally be organized into four basic categories of financial information, as described below.

a. Profitability (Income or Cash Flow Based) Ratios

Profitability measures reflect the current response of market forces to the products manufactured and/or sold by the firm, and may indicate the ongoing profit-making potential of an operation. Since a firm's ultimate existence relies on the earning power of its assets, measures of this type should reflect the future stability of a firm. The most straightforward measure of profitability is net after-tax income (NI). Beaver (1968) tested the predictive power of these ratios of net income to sales, total assets, net worth, and total debt, and found the net income/total asset (NI/TA) ratio to have the most discriminating power. NI/TA has also been employed in a number of other studies (Deakin 1972, 1977; McWilliams, 1977). Beaver identified cutoff points for this ratio ranging from 0 to .04, depending on the number of years prior to bankruptcy the test was applied. McWilliams, in deriving qualitative descriptors for financial ratio data, assigned a plus to a firm with NI/TA greater than .04, and a minus to those with NI/TA below 0.

Altman (1968, 1977) proposed the use of earnings before interest and taxes (EBIT) as a substitute for net income. Theoretically, EBIT has the advantage of excluding discontinuities in income trends resulting from one-time extraordinary charges. However, EBIT fails to take into account the penalties to profitability suffered by a highly leveraged firm, as the result of interest payments. More importantly, Altman has never published results which compare the actual predictive abilities of EBIT versus NI. Since EBIT values are not always clearly identified in income account statements (particularly in the case of smaller firms), EBIT was not included in the list of variables tested.

Measures of cash flow (CF) have been observed in past studies to provide forecasting ability superior to net income ratios. The two most popular formulations of cash flow ratios are cash flow/total liabilities (in which CF = NI + depreciation), and cash flow/total debt (in which CF = NI + depreciation - dividends, and total debt = long-term debt + the current portion of long-term debt). Preliminary analysis indicated that certain key industries (most significantly, electric utilities) performed much worse on the latter of these two ratios. Consequently, the CF/TL ratio was used in the preliminary evaluation of tests. Beaver used cutoff points for cash flow/total debt of .03 to .11; McWilliams considered the cutoff points to be .15 to .35.

b. Liquidity Ratios

Liquidity ratios define the capability of a firm to respond to short-term or emergency expenditure needs without borrowing. Since the Agency may call on firms to close their facilities immediately, the

194

availability of liquid assets to cover these costs is particularly relevant. Four measures of liquid assets are commonly employed: current assets (CA); quick assets (QA), defined as current assets minus inventories; net working capital (NWK), defined as current assets minus current liabilities (CL); and cash (including marketable securities). These measures are commonly contrasted to either current liabilities or total assets (TA).

Altman et al. in 1977 found the current ratio (CA/CL, or CURRAT) to be the most accurate predictive measure of firm stability, while in 1968 Altman used the ratio NWK/TA as his liquidity measure. Beaver (1968) obtained equivalent predictive results using both measures, as well as the quick ratio (QA/CL, or QRAT). Deakin (1972) used all seven variables (CURRAT, QRAT, Cash/CL, CA/TA, NWK/TA, Cash/TA) in his 14-variable multi-discriminant equation. In his refined five-variable model (1977), only CURRAT, CA/TA, and Cash/TA are used.

c. Leverage Ratios

Leverage ratios illustrate the percentage of a firm's total assets that are tied to short-term or long-term liabilities. A highly leveraged company may have substantial liquid or long-term assets on hand, but they may be secured by other creditors if the firm's financial condition begins to deteriorate. There are several alternate measures of leverage. Beaver (1968) looked at a number of ratios that contrasted current and other liabilities to total assets, and found total debt/total assets to be the most effective. Altman (1968) found that the ratio of the market value of common and preferred stock to equity provided better predictive results than other debt/equity measures, although the relative performance of the tested ratios was not documented. Long-term bond analysts cited the total liability (TL)/net worth (NW) ratio as the most important variable influencing their judgment (Backer and Gosman, 1978). The Agency used a TL/NW ratio as a measure of a firm's leverage in its preliminary evaluations. The common application in the business community and ease of calculation of this ratio make it an appealing candidate for these analytical purposes.

d. Turnover Ratios

Both Beaver (1968) and Altman (1968) tested a number of ratios relating various asset categories to net sales figures. Such turnover ratios are commonly used by analysts to measure the sales-generating capability of assets, or to indicate management's effectiveness in the competitive marketplace. Although these ratios have traditionally shown very poor predictive power when used independently, Altman, in his 1968 Z-score model, included a net sales (NS)/TA ratio, and rated it the second most important contributor to the overall discriminating power of his function. However, research by the Agency revealed that such a ratio severely discriminates against a number of industry categories (e.g., electric utilities; firms with large extractive interests, such as mining, gas, oil and timber).

4. Ratios Selected

Seven financial ratios were selected for detailed evaluation as candidates for inclusion in a financial test. These ratios were chosen from the many identified because they satisfied three primary

196

conditions: (1) they had been quantitatively validated as significant predictive variables by previous research efforts; (2) they had been frequently identified by bond rating services and credit analysts as key parameters; and (3) their values could be readily obtained from Consolidated Income Account or Consolidated Balance Sheet data. The seven ratios selected were:

Cash flow/total liabilities (CF/TL)
Net income/total assets (NI/TA)
Total liabilities/net worth (TL/NW)
Current assets/current liabilities (CURRAT, or current ratio)
Quick assets/current liabilities (QRAT, or quick ratio)
Net working capital/total assets (NWK/TA)
Net sales/total assets (NS/TA)

D. Summary Financial Data for the Firm Samples

Financial data from the companies included in the bankrupt and non-bankrupt firm samples are summarized in Tables III-3 through III-6. Table III-3 summarizes the primary bankrupt sample; Table III-4, the primary non-bankrupt sample; Table III-5, the holdout bankrupt sample; and Table III-6, the holdout non-bankrupt sample. The three years of data collected for each sample are hereafter referred to as years x-1, x-2, and x-3. For each sample, values for eight financial parameters are detailed in the tables: net income (NI), cash flow (CF), quick assets (QA), current assets (CA), total assets (TA), current liabilities (CL), total liabilities (TL), and net worth (NW). The right-hand portions of the Tables for the primary samples (Tables III-3 and III-4) indicate each firm's performance in the six major financial ratio categories used in this analysis: cash flow/total liabilities, total liabilities/net worth, net fixed assets/total assets, net income/total assets, current assets/current liabilities, and quick assets/current liabilities. Because the net income/total assets ratio was not included in any of the tests evaluated against the holdout samples, this ratio is not included in Tables III-5 and III-6.

Reproduced from
best available copy.

199

TABLE III-3

FINANCIAL DATA FOR FIRMS IN PRIMARY BANKRUPT SAMPLE

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1]	CF/TL[2]	TL/NW[3]	CURRAT[4]	QRAT[5]	NI/TA[6]
Alan Wood Steel	1978(x-1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	(x-2)	-15.0	-7.2	18.7	33.7	41.4	88.0	32.0	120.0	P	F	F	F	F	F
	(x-3)	-9.4	-1.4	18.4	34.1	29.2	79.0	47.0	126.0	P	F	1.7	F	F	F
Allied Leisure	1977(x-1)	-3.0	-2.8	0.3	2.2	4.4	4.4	-1.3	3.1	F	F	P	F	F	F
	(x-2)	-0.2	-0.1	1.2	2.3	2.0	2.0	2.1	4.0	F	F	P	F	F	F
	(x-3)	-0.3	-0.2	1.3	3.2	1.4	1.4	2.3	3.7	F	F	P	P	F	F
American Beef Packers	1975(x-1)	4.8	7.1	47.7	78.2	72.2	97.4	22.6	120.0	P	F	F	F	F	4.0
	(x-2)	3.4	5.3	49.6	82.0	74.8	90.3	17.7	108.0	23.6	F	F	F	F	3.1
	(x-3)	1.1	2.3	31.3	40.4	35.4	45.7	14.3	60.0	P	F	F	F	F	F
American Book	1973(x-1)	0	1.2	8.8	9.9	15.5	12.2	6.6	18.8	P	F	1.8	F	F	F
	(x-2)	-2.4	-1.2	11.0	12.9	6.3	17.5	6.6	24.1	P	F	F	P	P	F
	(x-3)	0.1	1.3	13.6	15.5	6.9	16.5	12.8	29.3	P	F	1.3	P	P	F
Armac Industries	1976(x-1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	(x-2)	-6.8	NA	13.2	29.5	24.0	27.3	5.9	33.2	F	F	F	F	F	F
	(x-3)	2.4	3.0	10.7	30.5	17.7	22.3	11.7	34.0	F	13.5	1.9	1.7	F	P
Astrodata	1970(x-1)	0.2	0.7	10.7	10.6	5.8	11.1	2.3	13.4	F	F	F	1.8	P	F
	(x-2)	-6.7	-6.4	11.4	11.7	18.0	23.3	-8.7	14.6	F	F	F	F	F	F
	(x-3)	-5.9	0	9.5	16.7	17.4	21.7	-1.0	20.7	F	F	F	F	F	F
Barrington Industries	1976(x-1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	(x-2)	0.3	NA	3.6	5.9	5.6	7.7	1.2	8.9	F	F	F	F	F	3.4
	(x-3)	0.1	NA	3.6	5.6	6.9	9.6	2.5	12.1	F	F	F	F	F	F
Bishop Industries	1970(x-1)	-3.4	-3.0	4.7	8.7	4.5	14.0	2.3	16.3	F	F	F	1.9	1.0	F
	(x-2)	-7.6	-7.3	4.5	11.1	10.2	16.3	2.2	18.5	F	F	F	F	F	F
	(x-3)	0.2	0.4	12.2	17.7	9.1	15.2	7.0	22.2	F	F	F	1.9	P	F
Bowmar Instruments	1975(x-1)	-25.6	-24.1	20.9	43.9	20.4	51.5	3.5	55.0	F	F	F	P	1.0	F
	(x-2)	7.6	8.1	24.0	42.7	30.1	33.9	14.8	48.7	F	P	F	F	F	P
	(x-3)	2.0	2.4	10.7	18.2	10.5	13.4	7.1	20.5	F	17.9	1.9	1.7	1.0	P
Computer Applications	1970(x-1)	-2.1	-1.4	14.4	17.4	13.3	33.2	1.0	34.3	F	F	F	F	1.1	F
	(x-2)	0.6	1.2	14.2	17.2	17.1	23.0	11.2	34.2	23.6	F	F	F	F	F
	(x-3)	0.7	1.6	9.9	11.3	7.6	14.6	7.2	21.8	25.2	11.0	F	F	P	3.2
Diversa	1969(x-1)	6.7	6.9	0.7	0.7	7.6	39.3	6.6	46.4	F	17.3	F	F	F	P
	(x-2)	-7.3	-6.4	17.1	22.2	32.5	73.1	3.0	76.1	F	F	F	F	F	F
	(x-3)	-7.4	-6.8	6.0	13.7	27.7	80.3	10.4	90.7	F	F	F	F	F	F

[1] P > 30.0 (passes all tests); F < 20.0 (fails all tests)

[2] P > 20.0 (passes all tests); F < 10.0 (fails all tests)

[3] P < 1.0 (passes all tests); F > 2.0 (fails all tests)

[4] P > 2.0 (passes all tests); F < 1.5 (fails all tests)

[5] P > 1.2 (passes all tests); F < 1.0 (fails all tests)

[6] P > 4.0 (passes all tests); F < 2.0 (fails all tests)

TABLE III-3
(continued)

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1]	CF/TL[2]	TL/NW[3]	CURRAT[4]	QRAT[5]	NI/TA[6]
Dolly Madison	1970(x-1) (x-2) (x-3)	-3.5 4.6 0.8	-0.1 6.9 2.4	22.5 18.4 7.4	48.2 41.4 14.1	46.5 30.9 7.1	68.1 48.0 20.4	24.3 25.8 14.9	92.4 73.8 35.3	P P P	F 14.4 11.8	F 1.9 1.4	F F 2.0	F F 1.0	F P 2.3
Esgro Corporation	1973(x-1) (x-2) (x-3)	-4.6 -1.5 0.7	-4.3 -1.0 1.0	8.4 11.2 9.5	20.9 24.4 22.7	16.1 15.5 10.6	26.0 24.3 20.3	1.6 6.2 7.6	27.6 30.5 27.9	F F F	F F F	F F F	F 1.6 P	F F F	F F 2.5
Fotochrome Industries	1970(x-1) (x-2) (x-3)	0.5 0.1 -1.8	1.0 0.6 -1.3	3.7 2.6 1.8	6.0 5.1 4.3	4.0 3.7 3.2	7.6 8.0 6.6	4.7 3.0 2.4	12.3 11.0 9.0	P P P	13.2 F F	1.6 F F	1.5 F F	F F F	P F F
General Alloys	1973(x-1) (x-2) (x-3)	NA -0.7 -0.1	NA -0.6 0	NA 0.6 1.0	NA 1.4 2.0	NA 2.0 1.9	NA 2.1 2.3	NA 0.4 1.0	NA 2.5 3.3	NA P P	NA F F	NA F F	NA F F	NA F F	NA F F
GF Industries	1970(x-1) (x-2) (x-3)	-1.3 -0.6 0.3	0 -0.4 0	3.5 4.7 2.0	5.1 5.8 3.4	1.9 1.5 1.4	4.4 1.5 1.5	5.2 5.8 2.5	9.6 7.3 4.0	F F F	F F F	P P P	P P P	P P P	F F P
Gray Manufacturing	1975(x-1) (x-2) (x-3)	-3.0 0.1 0.9	-2.6 0.4 1.1	7.0 8.1 7.3	17.3 16.8 10.7	13.3 7.5 3.2	18.3 13.6 9.4	6.1 9.8 8.0	24.4 23.4 17.4	F F F	F F 11.7	F 1.4 1.2	F P P	F 1.1 P	F F P
Gruen Industries	1977(x-1) (x-2) (x-3)	-0.2 -2.5 0.2	0 -2.4 0.3	5.2 5.0 5.0	14.7 12.2 13.8	7.8 7.7 6.4	10.5 7.8 6.7	4.7 4.8 7.5	15.2 12.6 14.2	F F F	F F F	F 1.6 P	1.9 1.6 P	F F F	F F F
Harvard Industries	1972(x-1) (x-2) (x-3)	-7.8 -11.0 1.6	-5.5 -8.4 3.8	13.8 21.9 21.4	24.5 42.8 53.0	17.1 30.2 36.0	43.7 59.0 59.3	4.3 12.0 23.1	48.0 71.0 82.4	P P 29.6	F F F	F F F	F F F	F F F	F F F
King Resources	1971(x-1) (x-2) (x-3)	-53.0 25.5 12.0	-42.8 28.0 13.2	30.4 30.4 30.4	30.4 72.0 59.1	64.7 68.0 20.9	103.7 106.1 66.4	24.3 70.9 39.6	128.0 177.0 106.0	F F F	F P 19.9	F 1.5 1.7	F F P	F F P	F P P
Maule Industries	1976(x-1) (x-2) (x-3)	-8.7 2.5 10.2	-1.4 8.6 15.4	10.9 22.0 17.6	24.9 33.5 27.5	60.7 40.6 21.6	121.8 114.0 57.5	67.2 76.0 65.5	189.0 190.0 123.0	P P P	F F P	1.8 1.5 P	F F F	F F F	F F P
Michigan Bakeries	1971(x-1) (x-2) (x-3)	-0.1 -0.5 -0.3	0.1 -0.3 -0.1	0.6 0.7 0.8	0.7 0.8 0.9	1.1 1.2 1.0	1.4 1.6 1.1	0.4 0.5 0.9	1.8 2.1 2.0	F F F	F F F	F F 1.2	F F F	F F F	F F F
Milo Electronics	1970(x-1) (x-2) (x-3)	-0.9 0.1 0.2	-0.8 0.2 0	3.0 2.7 2.8	11.8 11.4 10.0	6.7 5.3 4.9	8.3 7.1 6.9	4.9 5.9 4.2	13.2 13.0 11.1	F F F	F F F	1.7 1.2 1.6	1.8 P P	F F F	F F F
National Radio	1967(x-1) (x-2) (x-3)	-0.6 0.1 0.8	NA NA NA	3.5 4.0 2.2	5.0 5.2 3.5	3.3 3.3 0.6	4.3 4.3 2.0	2.4 2.6 2.6	6.7 6.9 4.6	F F F	P P P	1.8 1.7 P	1.5 1.6 P	P P P	F F P

TABLE III-3
(continued)

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1]	CF/TL[2]	TL/NW[3]	CURRAT[4]	QRAT[5]	NI/TA[6]
National Video	1969(x-1)	-5.3	-2.1	5.7	12.7	5.2	8.2	19.3	27.5	P	F	P	P	1.1	F
	(x-2)	2.2	5.8	7.8	13.3	3.8	4.5	24.5	29.0	P	P	P	P	P	P
	(x-3)	7.3	9.3	16.1	23.6	14.1	14.9	23.8	38.7	P	P	P	1.7	1.1	P
Omega Alpha	1973(x-1)	41.7	47.4	27.9	50.8	40.5	145.9	33.1	179.0	P	P	F	F	F	P
	(x-2)	0.6	2.4	54.4	95.9	65.5	156.5	31.5	188.0	P	F	F	F	F	F
	(x-3)	2.0	6.7	39.1	74.5	41.9	111.8	63.2	175.0	P	F	1.8	1.8	F	F
Paterson Parchment	1974(x-1)	-2.2	0	4.4	10.3	5.4	11.2	7.3	18.5	P	F	1.5	1.9	F	F
	(x-2)	-0.8	0	5.0	11.2	4.6	10.2	9.5	19.7	P	F	1.1	P	P	F
	(x-3)	-1.3	-0.5	6.1	12.1	5.0	11.1	10.6	21.7	P	F	1.0	P	P	F
Permaneer Company	1976(x-1)	-15.7	-12.2	7.8	19.0	13.9	67.2	-11.6	55.6	P	F	F	F	F	F
	(x-2)	-17.2	-13.6	14.1	36.1	19.1	74.6	4.1	78.7	P	F	F	1.9	P	F
	(x-3)	-3.0	-0.4	18.5	42.5	14.7	62.0	21.3	83.3	P	F	F	P	P	F
Photon	1972(x-1)	1.3	1.8	16.0	34.9	8.7	23.0	17.5	40.5	F	F	1.3	P	P	3.2
	(x-2)	-1.0	-0.6	14.0	31.3	6.2	20.5	15.1	35.6	F	F	1.4	P	P	F
	(x-3)	1.0	1.2	17.4	32.4	5.6	21.9	15.7	37.6	F	F	1.4	P	P	2.7
Polarad Electronics	1970(x-1)	0.4	0.6	1.7	4.0	1.5	3.6	1.5	5.1	F	16.7	F	1.6	F	P
	(x-2)	-1.5	-1.4	2.3	5.4	4.5	4.6	1.8	6.4	F	F	F	F	F	F
	(x-3)	0.2	0.4	2.0	5.1	2.8	2.9	3.1	6.0	F	13.8	P	1.8	F	3.3
Reading Industries	1976(x-1)	-2.1	-1.2	3.2	9.2	14.2	16.5	3.8	20.3	P	F	F	F	F	F
	9x-2)	-3.3	-2.4	4.9	11.1	3.6	16.9	5.9	22.8	P	F	F	P	P	F
	(x-3)	1.1	2.0	8.8	16.6	5.8	20.1	9.2	29.3	P	F	F	P	P	3.8
Redcor Corporatio n	1972(x-1)	-5.6	-4.6	2.4	7.3	4.8	8.7	2.0	10.7	F	F	F	1.5	F	F
	(x-2)	-4.8	-4.6	2.9	11.0	8.0	8.7	3.9	12.6	F	F	F	F	F	F
	(x-3)	-0.1	0	2.3	4.3	1.7	2.8	3.7	6.5	F	F	P	P	P	F
Remco Industries	1971(x-1)	-10.8	-8.8	10.0	14.0	13.0	16.3	1.3	17.6	F	F	F	F	F	F
	(x-2)	-0.7	1-0	11.4	17.8	13.7	16.9	8.1	25.0	24.3	F	F	F	F	F
	(x-3)	2.0	3.5	10.7	13.6	6.8	9.4	8.9	18.3	22.5	P	1.1	P	P	P
Scottex	1973(x-1)	-2.4	0	10.1	19.3	12.1	22.7	8.0	30.7	P	F	F	P	F	F
	(x-2)	1.1	0	6.0	13.8	7.5	13.4	10.4	23.8	P	F	1.3	1.8	F	P
	(x-3)	0.8	1.1	3.8	7.7	6.7	9.9	2.9	12.8	P	11.1	F	F	F	P
Sequoyah Industries	1973(x-1)	-0.6	0.3	5.7	13.3	8.4	29.0	2.8	31.8	P	F	F	1.6	F	F
	(x-2)	-9.5	-8.3	3.5	12.5	12.9	27.0	3.8	30.8	P	F	F	F	F	F
	(x-3)	-10.4	-9.2	15.0	29.1	24.3	39.7	15.5	55.2	P	F	F	F	F	P
Sheffield Watch	1971(x-1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	(x-2)	0.7	0.8	9.6	21.6	12.2	17.2	5.3	22.5	F	F	F	1.8	F	3.1
	(x-3)	0.4	0.7	5.6	15.6	9.3	10.7	5.6	16.3	F	F	1.9	1.7	F	2.5
Stellar Industries	1975(x-1)	-1.7	-1.3	2.4	3.8	4.5	7.9	0.1	8.0	P	F	F	F	F	F
	(x-2)	-4.0	-3.5	2.0	3.9	4.7	10.4	-0.8	9.6	P	F	F	F	F	F
	(x-3)	-1.7	-1.3	3.5	7.0	6.6	10.8	2.7	13.5	28.6	F	F	F	F	F

201

TABLE III-3
(concluded)

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1/]	CF/TL[2/]	TL/NW[3/]	CURRAT[4/]	QRAT[5/]	NI/TA[6/]
Technical Measurements	1968(x-1)	1.9	2.8	6.7	10.0	2.7	3.1	16.5	19.6	P	P	P	P	P	P
	(x-2)	-2.1	-1.8	2.6	5.0	4.5	6.0	0.5	6.5	F	F	F	F	F	F
	(x-3)	-1.8	-1.5	4.9	9.1	5.6	7.5	5.5	13.0	F	F	1.3	1.6	F	F
Trans-Beacon	1970(x-1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	(x-2)	0.2	0.3	1.5	1.6	1.5	2.6	0.7	3.3	25.2	F	F	F	1.0	P
	(x-3)	0.3	0.4	1.3	1.4	1.2	3.7	-0.8	2.9	P	F	F	F	1.1	P
Waltham Industries	1971(x-1)	-13.9	0	8.9	27.0	30.8	43.9	1.1	45.0	26.8	F	F	F	F	F
	(x-2)	0.3	1.8	13.8	34.7	21.9	47.9	15.3	63.2	28.1	F	F	1.6	F	F
	(x-3)	1.6	2.4	9.6	18.6	8.1	21.1	11.2	32.3	29.2	11.4	1.9	P	1.2	P
Westgate California	1972(x-1)	-2.6	2.7	22.8	41.3	34.0	143.6	30.4	174.0	P	F	F	F	F	F
	(x-2)	2.8	7.2	46.3	63.8	76.9	182.0	33.0	215.0	P	F	F	F	F	F
	(x-3)	3.6	6.8	19.6	32.1	32.2	116.7	34.3	151.0	P	F	F	F	F	2.4

Reproduced from best available copy.

203

TABLE III-4

FINANCIAL DATA FOR FIRMS IN THE PRIMARY NON BANKRUPT SAMPLE

Name of Firm	Year 1/	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA 2/	CF/TL 3/	TL/NW 4/	CURRAT 5/	QRAT 6/	NI/TA 7/
Alcoa	(x-1)	65	235	400	1021	377	1845	1575	3620	P	12.8	1.17	P	1.06	F
	(x-2)	173	338	474	1040	472	1651	1547	3198	P	P	1.06	P	1.00	P
	(x-3)	104	263	453	905	308	1412	1409	2821	P	18.6	1.00	P	P	1.7
Allegheny Ludlum	(x-1)	30	50	119	325	141	318	320	638	P	15.8	P	P	F	P
	(x-2)	45	64	153	379	184	352	304	656	P	18.2	1.16	P	F	P
	(x-3)	31	49	135	320	146	317	270	588	P	15.5	1.17	P	F	P
Altamil	(x-1)	1	2	8	16	3	4	17	21	22.3	P	P	P	P	P
	(x-2)	.7	2	13	26	12	16	15	31	F	10.3	1.01	P	1.05	2.3
	(x-3)	3	3	9	21	8	12	15	27	20.9	P	P	P	1.10	P
Alumax	(x-1)	21	23	117	217	54	183	279	462	P	12.5	P	P	P	P
	(x-2)	36	36	99	179	60	118	259	377	F	P	P	P	P	P
	(x-3)	16	16	81	139	51	71	201	272	F	P	P	P	P	P
Amax	(x-1)	134	193	451	677	331	1116	1364	2480	P	17.3	P	P	P	P
	(x-2)	148	194	261	404	207	826	942	1768	P	P	P	1.95	P	P
	(x-3)	105	142	417	535	209	812	840	1652	P	17.5	P	P	P	P
Ameron	(x-1)	8	14	41	70	29	67	68	135	P	P	P	P	P	P
	(x-2)	7	12	48	87	39	82	62	144	P	14.9	1.32	P	P	P
	(x-3	6	11	35	60	25	56	58	114	P	18.6	P	P	P	P
Ametek	(x-1)	13	16	43	85	35	54	67	121	29.6	P	P	P	P	P
	(x-2)	11	15	32	78	36	57	59	117	P	P	P	P	F	P
	(x-3)	9	13	30	70	29	48	53	102	29.2	P	P	P	1.03	P
Ampco-Pittsburgh	(x-1)	6	8	14	3 8	12	15	50	65	25.8	P	P	P	P	P
	(x-2)	9	10	16	43	17	22	45	67	20.7	P	P	P	1.04	P
	(x-3)	5	6	13	35	13	18	38	56	21.4	P	P	P	1.02	P
Amsted	(x-1)	35	45	98	157	75	79	179	258	P	P	P	1.54	P	P
	(x-2)	17	26	71	129	61	65	153	218	P	P	P	P	1.16	P
	(x-3)	15	24	63	117	50	61	144	205	P	P	P	P	F	P
Anken	(x-1)	.7	1	4	7	2	2	10	12	P	P	P	P	P	P
	(x-2)	.6	1	4	7	3	3	9	12	P	P	P	P	P	P
	(x-3)	1	2	4	7	3	3	9	12	P	P	P	P	P	P
Armco Steel	(x-1)	117	209	438	1003	415	1276	1330	2606	P	16.3	P	P	1.06	P
	(x-2)	204	290	601	1124	554	1268	1274	2542	P	P	P	P	1.08	P
	(x-3)	107	190	438	853	372	1114	1145	2259	P	17.1	P	P	1.18	P
ASARCO	(x-1)	26	62	195	442	174	641	861	1502	P	F	P	P	1.12	F
	(x-2)	126	161	182	408	234	466	863	1329	P	P	P	1.74	F	P
	(x-3)	113	140	171	364	196	375	774	1149	P	P	P	1.86	F	P

1/ For all firms, x-1 is 1975, x-2 is 1974, and x-3 is 1973

2/ P > 30.0 (passes all tests); F < 20.0 (fails all tests)

3/ P > 20.0 (passes all tests); F < 10.0 (fails all tests)

4/ P < 1.0 (passes all tests); F > 2.0 (fails all tests)

5/ P > 2.0 (passes all tests); F < 1.5 (fails all tests)

6/ P > 1.2 (passes all tests); F < 1.0 (fails all tests)

7/ P > 4.0 (passes all tests); F < 2.0 (fails all tests)

TABLE III-4
(continued)

Name of Firm	Year[1]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2]	CF/TL[3]	TL/NW[4]	CURRAT[5]	QRAT[6]	NI/TA[7]
ASPRO	(x-1)	2	4	13	23	12	23	15	38	P	16.3	1.53	1.95	1.06	P
	(x-2)	2	3	11	19	9	21	13	34	P	13.7	1.55	P	P	P
	(x-3)	2	3	10	18	8	18	12	30	P	15.6	1.48	P	P	P
Athlone	(x-1)	12	15	43	85	32	109	50	159	27.5	13.7	F	P	P	P
	(x-2)	13	16	50	96	45	122	48	170	24.1	13.3	F	P	1.11	P
	(x-3)	7	10	32	77	30	112	40	152	25.7	F	F	P	1.07	P
Basic	(x-1)	3	5	10	25	8	22	27	49	P	P	P	P	P	P
	(x-2)	4	6	14	27	9	21	25	46	P	P	P	P	P	P
	(x-3)	2	5	11	24	8	23	22	45	P	P	1.02	P	P	P
Bernz-O-Matic	(x-1)	-2	-1	4	12	4	10	8	18	P	F	1.30	P	1.05	F
	(x-2)	.8	1	7	14	5	11	9	20	23.5	11.7	1.19	P	P	3.9
	(x-3)	2	2	6	14	6	9	9	17	F	P	1.01	P	1.11	P
Bethlehem Steel	(x-1)	242	476	768	1388	719	1180	2612	4592	P	P	P	1.93	1.07	P
	(x-2)	342	553	1172	1682	1032	2023	2490	4513	P	P	P	1.63	1.14	P
	(x-3)	207	403	934	1376	713	1677	2242	3919	P	P	P	1.93	P	P
Bliss & Laughlin	(x-1)	10	14	37	64	14	52	68	120	21.9	P	P	P	P	P
	(x-2)	9	14	24	56	19	50	62	112	24.1	P	P	P	P	P
	(x-3)	8	12	29	56	16	56	57	113	23.6	P	P	P	P	P
Brooks & Perkins	(x-1)	1	1	5	11	4	7	6	13	F	18.6	1.17	P	1.15	P
	(x-2)	.5	.8	4	8	4	5	5	10	F	17.4	P	1.81	F	P
	(x-3)	.5	.8	3	7	3	3	6	8	20.2	P	P	P	P	P
Bundy Corporation	(x-1)	4	8	19	29	10	21	50	71	P	P	P	P	P	P
	(x-2)	.3	4	19	29	11	23	49	72	P	16.2	P	P	P	F
	(x-3)	8	11	21	33	13	25	52	78	P	P	P	P	P	P
Carpenter	(x-1)	22	23	47	113	34	55	139	194	P	P	P	P	P	P
	(x-2)	17	24	49	117	40	65	124	189	P	P	P	P	P	P
	(x-3)	14	20	40	100	28	55	112	167	P	P	P	P	P	P
Ceco	(x-1)	9	14	60	98	26	58	92	150	P	P	P	P	P	P
	(x-2)	11	17	50	100	31	63	87	150	30.0	P	P	P	P	P
	(x-3)	10	15	46	92	31	65	80	145	P	P	P	P	P	P
Cerro	(x-1)	-2	11	208	311	147	380	341	721	NA	F	P	P	P	P
	(x-2)	16	24	247	338	154	396	369	765	F	11.1	1.07	P	P	2.1
	(x-3)	15	22	185	253	80	298	362	660	F	F	P	P	P	2.3
CF&I	(x-1)	38	64	85	127	71	127	182	309	P	P	P	1.78	1.20	P
	(x-2)	35	60	79	115	46	107	181	288	P	P	P	P	P	P
	(x-3)	14	33	62	92	53	117	168	285	P	P	P	1.72	1.15	P
Cleveland-Cliffs	(x-1)	31	34	58	75	32	68	216	284	F	P	P	P	P	P
	(x-2)	26	26	72	81	30	56	203	259	F	P	P	P	P	P
	(x-3)	21	21	70	78	18	33	185	218	F	P	P	P	P	P

204

TABLE III-4
(continued)

Name of Firm	Year[1]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2]	CF/TL[3]	TL/NW[4]	CURRAT[5]	QRAT[6]	NI/TA[7]
Commercial Metals	(x-1)	9	12	58	99	38	62	59	120	F	P	1.05	P	P	P
	(x-2)	19	22	77	124	81	95	50	145	F	P	1,90	1.54	F	P
	(x-3)	5	8	52	81	55	66	32	98	F	11.7	F	F	F	P
Consyne	(x-1)	1	2	4	8	2	3	9	12	F	P	P	P	P	P
	(x-2)	1	2	4	8	2	3	9	12	F	P	P	P	P	P
	(x-3)	1	2	4	7	3	3	8	11	F	P	P	P	P	P
Copper Range	(x-1)	-14	-6	28	62	19	58	128	186	P	F	P	P	P	F
	(x-2)	18	26	55	86	15	61	119	180	P	P	P	P	P	P
	(x-3)	11	19	44	61	12	54	106	160	P	P	P	P	P	P
Copperweld	(x-1)	23	38	199	466	213	340	267	607	F	11.2	1,27	P	F	3.8
	(x-2)	17	21	47	97	42	69	89	158	P	P	P	P	1.12	P
	(x-3)	13	17	30	73	27	55	77	132	P	P	P	P	1.11	P
Crown Industries	(x-1)	.8	1	5	8	3	4	7	11	23.3	P	P	P	P	P
	(x-2)	1	2	5	9	4	5	7	12	22.0	P	P	P	P	P
	(x-3)	2	2	5	8	4	5	6	11	21.9	P	P	P	P	P
Cyclops	(x-1)	-7	7	70	173	88	166	138	304	P	F	1.20	1.97	F	F
	(x-2)	20	23	87	206	115	183	157	340	P	18.1	1.17	1.79	F	P
	(x-3)	9	22	77	180	91	165	145	310	P	13.2	1.14	1.98	F	P
Driver Harris	(x-1)	2	3	10	23	11	16	18	33	29.5	17.3	P	P	F	P
	(x-2)'	2	3	10	23	11	16	18	33	29.5	17.3	P	P	F	P
	(x-3)	1	2	11	20	9	14	16	30	P	15.0	P	P	1.20	3.7
Earth Resources	(x-1)	10	13	38	48	38	58	32	90	P	P	1.84	F	1.02	P
	(x-2)	7	11	32	41	37	47	24	71	P	P	1.92	F	F	P
	(x-3)	2	5	15	19	13	24	18	42	P	P	1.31	F	1.15	P
EASCO	(x-1)	7	11	26	64	27	52	46	97	P	P	1.13	P	F	P
	(x-2)	6	10	30	71	29	64	41	105	P	14.8	1,56	P	1.03	P
	(x-3)	6	9	27	58	37	53	36	89	P	16.6	1,47	1.57	F	P
Eastern	(x-1)	3	4	6	14	2	6	19	25	P	P	P	P	P	P
	(x-2)	3	3	8	17	5	9	18	27	P	P	P	P	P	P
	(x-3)	2	2	6	12	3	4	15	19	P	P	P	P	P	P
ELTRA	(x-1)	37	53	184	376	142	237	298	535	20.5	P	P	P	P	P
	(x-2)	35	49	192	373	146	242	273	515	F	P	P	P	P	P
	(x-3)	32	44	157	309	102	181	249	431	F	P	P	P	P	P
Florida Steel	(x-1)	7	10	17	40	11	24	53	77	P	P	P	P	P	P
	(x-2)	11	13	24	47	15	28	43	76	P	P	P	P	P	P
	(x-3)	6	8	19	36	9	21	39	60	P	P	P	P	P	P
General Steel	(x-1)	5	7	14	27	11	37	15	52	P	18.8	F	P	P	P
	(x-2)	5	7	14	28	11	41	10	51	P	16.3	F	P	P	P
	(x-3)	3	5	19	29	18	56	5	61	P	F	F	1,64	1.07	P

205

TABLE III-4
(continued)

Name of Firm	Year[1]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2]	CF/TL[3]	TL/NW[4]	CURRAT[5]	QRAT[6]	NI/TA[7]
Hanna	(x-1)	47	57	79	100	49	92	293	385	F	P	P	P	P	P
	(x-2)	21	30	75	97	49	114	283	397	F	P	P	1.96	P	P
	(x-3)	23	33	60	81	31	86	274	360	F	P	P	P	P	P
Harsco	(x-1)	36	59	135	224	59	152	206	358	P	P	P	P	P	P
	(x-2)	25	48	98	194	90	137	182	319	P	P	P	P	1.09	P
	(x-3)	22	42	91	162	64	107	164	271	P	P	P	P	P	P
Hofmann Industries	(x-1)	.7	2	7	18	12	16	14	30	P	12.5	1.16	1.58	F	2.3
	(x-2)	3	3	8	16	9	14	13	27	P	P	1.04	1.89	F	P
	(x-3)	1	2	8	16	11	16	11	27	P	11.9	1.43	1.56	F	P
Hoover Ball & Bearing	(x-1)	12	21	60	87	37	69	79	149	P	P	P	P	P	P
	(x-2)	11	17	39	72	31	70	73	143	P	P	P	P	P	P
	(x-3)	14	21	33	58	27	59	62	122	P	P	P	P	P	P
IMCO	(x-1)	166	199	267	469	284	630	458	1088	P	P	1.38	1.65	F	P
	(x02)	57	79	267	346	150	435	309	744	P	18.2	1.41	P	P	P
	(x-3)	26	41	183	260	128	305	250	555	P	13.4	1.22	P	P	P
Inland Steel	(x-1)	83	164	309	627	243	896	971	1867	P	18.3	P	P	P	P
	(x-2)	148	222	323	664	302	819	939	1758	P	P	P	P	1.07	P
	(x-3)	83	154	250	515	243	710	849	1559	P	P	P	P	1.01	P
Inspiration Consolidated	(x-1)	-4	7	28	60	13	54	115	169	P	13.3	P	P	P	F
	(x-2)	10	20	18	39	17	65	91	156	P	P	P	P	1.07	P
	(x-3)	15	21	36	47	15	68	88	156	P	P	P	P	P	P
Interlake	(x-1)	34	54	98	216	107	216	264	480	P	P	P	P	F	P
	(x-2)	39	55	124	250	155	254	242	496	P	P	1.05	1.61	F	P
	(x-3)	17	32	87	164	66	148	214	362	P	P	P	P	P	P
Kaiser Aluminum & Chemical	(x-1)	95	149	354	825	446	1304	798	2102	P	11.4	1.63	1.85	F	P
	(x-2)	104	157	401	799	452	855	1202	2057	P	18.4	P	1.77	F	P
	(x-3)	45	95	312	618	394	754	1060	1814	P	12.7	P	1.57	F	2.5
Kaiser Industries	(x-1)	79	213	212	305	189	657	632	1289	P	P	1.04	1.61	1.12	P
	(x-2)	31	91	219	334	202	692	577	1269	P	13.1	1.20	1.65	1.08	2.4
	(x-3)	45	97	219	313	191	688	550	1238	P	14.1	1.25	1.64	1.15	3.6
Kaiser Steel	(x-1)	80	113	134	216	125	329	458	787	P	P	P	1.72	1.07	P
	(x-2)	67	111	143	244	134	394	395	789	P	P	P	1.83	1.07	P
	(x-3)	53	96	144	224	135	422	336	758	P	P	1.26	1.66	1.07	P
Katy Industries	(x-1)	10	15	35	75	34	98	68	167	20.9	15.4	1.44	P	1.02	P
	(x-2)	10	15	35	75	34	98	68	167	20.9	15.4	1.44	P	1.02	P
	(x-3)	12	17	38	70	40	97	60	156	20.8	17.8	1.64	1.74	F	F
Kawecki-Berylco	(x-1)	-1	3	22	74	18	64	53	116	P	F	1.21	P	P	F
	(x-2)	7	10	21	72	14	57	55	112	29.0	17.3	1.64	P	P	P
	(x-3)	5	8	21	61	15	40	50	90	26.6	19.3	1.03	P	P	P

TABLE III-4
(continued)

Name of Firm	Year[1/]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2/]	CF/TL[3/]	TL/NW[4/]	CURRAT[5/]	QRAT[6/]	NI/TA[7/]
Kennecott	(x-1)	49	71	171	446	183	812	1411	2223	P	F	P	P	F	F
	(x-2)	211	302	317	606	287	767	1442	2209	P	P	P	P	1.10	P
	(x-3)	159	240	331	550	241	670	1307	1295	P	P	P	P	P	P
Keystone Consolidated	(x-1)	11	20	41	135	41	128	112	240	P	15.9	1.14	P	1.01	P
	(x-2)	10	15	39	124	55	122	103	225	P	12.2	1.18	P	F	P
	(x-3)	5	12	37	102	36	108	95	202	P	10.8	1.14	P	1.01	2.4
Kerr-McGee	(x-1)	131	190	338	567	285	579	809	1388	P	P	P	1.99	1.19	P
	(x-2)	116	187	298	496	294	510	655	1164	P	P	P	1.69	1.01	P
	(x-3	63	120	200	333	128	308	559	867	P	P	P	P	P	P
Kewanee	(x-1)	28	43	101	181	63	174	183	357	P	P	P	P	P	P
	(x-2)	29	42	66	116	42	74	170	244	P	P	P	P	P	P
	(x-3)	17	29	49	86	30	60	147	207	P	P	P	P	P	P
Kimberly-Clark	(x-1)	103	150	237	493	219	575	730	1305	P	P	P	P	1.08	P
	(x-2)	95	143	249	486	199	562	668	1229	P	P	P	P	P	P
	(x-3)	82	124	228	402	169	458	610	1068	P	P	P	P	P	P
Kin-Ark	(x-1)	.9	2	4	7	4	15	12	27	P	14.6	1.25	1.81	1.08	3.3
	(x-2)	1	2	4	7	6	17	11	27	P	13.9	1.54	F	F	P
	(x-3)	1	2	3	4	7	16	10	25	P	14.2	1.60	F	F	P
Koppers	(x-1)	60	91	214	369	150	311	368	680	P	P	P	P	P	P
	(x-2)	48	81	193	339	144	336	312	648	P	P	1.08	P	P	P
	(x-3)	30	58	151	255	107	246	274	520	P	P	P	P	P	P
Kraftco	(x-1)	140	192	318	1024	466	658	1009	1667	P	P	P	P	F	P
	(x-2)	95	144	337	1130	582	860	850	1710	P	16.7	1.01	1.94	F	P
	(x-3)	103	151	295	854	411	583	808	1391	P	P	P	P	F	P
Lehigh Valley Industries	(x-1)	2	4	8	32	18	53	6	59	23.7	F	F	1.81	F	3.9
	(x-2)	2	4	8	32	18	53	6	59	23.8	F	F	1.81	F	3.9
	(x-3)	3	4	8	32	19	55	4	59	23.1	F	F	1.74	F	P
Lilly & Co.	(x-1)	181	212	633	947	436	476	958	1434	P	P	P	P	P	P
	(x-2)	179	207	553	850	390	417	849	1265	29.3	P	P	P	P	P
	(x03)	156	182	450	667	268	290	730	1020	P	P	P	P	P	P
LTV Corporation	(x-1)	13	70	367	848	585	1602	361	1963	P	F	F	F	F	F
	(x-2)	112	197	645	1097	647	1686	344	2031	P	11.7	F	1.69	F	P
	(x-3)	50	130	498	871	515	1552	233	1785	P	F	F	1.69	F	2.8
Lubrizol	(x-1)	47	59	116	193	64	74	231	305	P	P	P	P	P	P
	(x-2)	51	61	112	191	80	89	203	292	P	P	P	P	P	P
	(x-3)	37	46	101	138	49	55	170	225	P	P	P	P	P	P
Lukens Steel	(x-1)	11	12	33	60	27	54	109	163	P	P	P	P	P	P
	(x-2)	11	NA	39	73	36	66	102	168	P	15.0	P	P	1.09	P
	(x-3)	7	NA	31	58	25	55	94	149	P	15.0	P	P	P	P

TABLE III-4
(continued)

Name of Firm	Year[1]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2]	CF/TL[3]	TL/NW[4]	CURRAT[5]	QRAT[6]	NI/TA[7]
MacAndrews Forbes	(x-1)	3	6	7	28	2	25	31	56	P	P	P	P	F	P
	(x-2)	2	5	8	26	10	23	29	52	P	P	P	P	F	P
	(x-3)	6	8	10	27	12	27	28	54	P	P	P	P	F	P
Mangood Corporation	(x-1)	.2	.5	4	7	4	8	4	12	P	F	1.86	P	1.20	F
	(x-2)	.1	F	6	9	5	9	4	13	P	F	F	1.84	P	F
	(x-3)	.2	F	5	7	3	6	5	11	P	F	1.33	P	P	F
Marathon Manufacturing	(x-1)	14	22	42	126	64	132	81	213	P	16.4	1.63	1.97	F	P
	(x-2)	7	13	42	138	68	160	68	228	P	F	F	P	F	3.1
	(x-3)	-19	-12	52	106	66	137	61	198	P	F	F	1.61	F	F
Martin Marietta	(x-1)	55	115	207	393	161	530	609	1139	P	P	P	P	P	P
	(x-2)	81	139	215	392	169	538	584	1121	P	P	P	P	P	P
	(x-3)	57	109	225	371	145	569	503	1072	P	19.2	1.13	P	P	P
McIntosh Corporation	(x-1)	1	3	10	15	5	7	23	30	P	P	P	P	P	P
	(x-2)	4	5	10	18	9	13	22	36	P	P	P	P	1.18	P
	(x-3)	4	5	10	15	5	9	20	28	P	P	P	P	P	P
McLouth	(x-1)	6	23	55	136	79	154	175	329	P	14.8	P	1.70	F	P
	(x-2)	22	41	75	130	65	144	177	321	P	P	P	P	1.15	P
	(x-3)	16	35	68	118	55	138	162	299	P	P	P	P	P	P
McNeil Corporation	(x-1)	4	6	33	95	36	61	71	131	25.1	10.5	P	P	F	2.7
	(x-2)	5	7	37	92	35	55	69	124	23.2	13.0	P	P	1.04	3.7
	(x-3)	6	8	30	77	27	40	66	106	23.9	P	P	P	1.13	P
Mead	(x-1)	53	94	245	371	192	560	532	1092	P	16.8	1.05	1.93	P	P
	(x-2)	82	120	219	381	213	552	509	1061	P	P	1.09	1.79	1.03	P
	(x-3)	50	82	190	336	152	486	459	945	P	16.8	1.06	P	P	P
Merck	(x-1)	229	281	447	857	355	624	950	1574	P	P	P	P	P	P
	(x-2)	211	257	332	723	363	420	823	1243	P	P	P	1.99	F	P
	(x-3)	183	223	335	580	238	279	710	989	P	P	P	P	P	P
Michigan Seamless Tube	(x-1)	10	13	14	32	15	23	42	65	P	P	P	P	F	P
	(x-2)	7	P	15	29	10	27	34	60	P	P	P	P	P	P
	(x-3)	4	P	13	26	9	19	29	48	P	P	P	P	P	P
Midland-Ross	(x-1)	21	31	140	209	104	169	182	351	26.1	18.5	P	P	P	P
	(x-2)	21	32	99	186	89	157	167	324	27.6	P	P	P	1.11	P
	(x-3)	12	21	76	141	57	130	152	282	P	15.8	P	P	P	P
Miles Laboratories	(x-1)	15	19	81	144	77	200	146	346	P	13.1	1.37	1.88	1.06	P
	(x-2)	16	26	60	149	105	198	137	335	P	13.2	1.45	F	F	P
	(x-3)	17	26	74	124	80	171	128	299	P	15.3	1.34	1.55	F	P
3M	(x-1)	262	417	795	1589	620	1194	1823	3017	P	P	P	P	P	P
	(x-2)	302	431	675	1577	921	1146	1695	2841	P	P	P	1.71	F	P
	(x-3)	296	405	743	1310	565	768	1513	2281	P	P	P	P	P	P

Reproduced from best available copy.

209

TABLE III-4
(continued)

Name of Firm	Year 1/	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA 2/	CF/TL 3/	TL/NW 4/	CURRAT 5/	QRAT 6/	NI/TA 7/
Mirro Aluminum	(x-1) (x-2) (x-3)	3 3 4	5 5 6	26 17 16	51 49 43	10 9 18	28 27 22	43 42 40	71 69 62	27.8 29.0 P	19.2 19.1 P	P P P	P P P	P P F	P P P
Mobil Oil	(x-1) (x-2) (x-3)	810 1047 849	1522 1560 1282	3954 3863 2986	6156 5827 3939	5234 5206 3375	8209 7638 4976	6841 6436 5715	15050 14074 10690	P P P	18.5 P P	1.20 1.19 P	F F F	F F F	P P P
Molycorp	(x-1) (x-2) (x-3)	8 14 8	16 22 14	10 12 14	30 32 30	8 15 13	42 50 42	92 77 75	134 127 117	P P P	P P P	P P P	P P P	1.14 F 1.12	P P P
Morton Norwich	(x-1) (x-2) (x-3)	18 25 24	35 41 39	107 105 96	201 191 164	59 89 61	222 208 186	238 231 217	460 439 403	P P P	15.7 19.7 P	P P P	P P P	P 1.17 P	3.8 P P
Nalco Chemical	(x-1) (x-2) (x-3)	32 27 25	44 36 32	77 58 71	118 100 100	47 41 30	58 49 35	158 138 122	216 187 157	P P 27.4	P P P	P P P	P P P	P P P	P P P
National Chemsearch	(x-1) (x-2) (x-3)	17 14 10	19 14 10	64 50 42	86 67 52	34 21 15	43 29 20	74 59 48	117 88 68	20.0 P P	P P P	P P P	P P P	P P P	P P P
National Distillers	(x-1) (x-2) (x-3)	62 90 72	89 117 101	328 315 341	629 641 629	163 181 174	429 454 504	595 565 505	1024 1019 1009	P P P	P P P	P P P	P P P	P P P	P P P
National Industries	(x-1) (x-2) (x-3)	15 17 14	22 NA NA	93 100 66	182 197 154	110 143 101	189 219 182	92 86 81	281 305 263	F F 21.2	11.7 10.0 10.0	F F F	1.65 F 1.53	F F F	P P P
National Service	(x-1) (x-2) (x-3)	18 23 23	29 33 32	87 90 87	139 161 138	45 74 55	74 104 85	155 148 140	229 252 225	P P P	P P P	P P P	P P P	P P P	P P P
National Starch & Chem.	(x-1) (x-2) (x-3)	19 18 17	25 25 23	58 42 36	100 89 70	32 33 28	84 69 47	130 116 102	214 185 149	P P P	P P P	P P P	P P P	P P P	P P P
National Steel	(x-1) (x-2) (x-3)	58 176 98	171 286 207	318 578 423	763 857 681	503 581 431	1201 1096 958	1209 1192 1067	2410 2289 2024	P P P	14.2 P P	P P P	1.52 F 1.58	F F F	2.4 P P
New England Nuclear	(x-1) (x-2) (x-3)	3 3 2	4 4 3	8 11 9	11 13 11	3 3 3	4 4 3	19 16 13	23 20 16	P P 28.8	P P P	P P P	P P P	P P P	P P P
Newmont Mining	(x-1) (x-2) (x-3)	53 114 103	85 140 123	129 123 110	298 266 186	126 124 72	481 440 379	648 637 564	1129 1077 944	P P P	17.7 P P	P P P	P P P	1.02 F P	P P P

TABLE III-4
(continued)

Name of Firm	Year1/	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA2/	CF/TL3/	TL/NW4/	CURRAT5/	QRAT6/	NI/TA7/
NL Industries	(x-1) (x-2) (x-3)	46 78 47	80 110 76	223 221 268	493 494 459	178 210 190	540 535 544	520 499 444	1060 1034 988	P P P	14.9 P 14.0	1.04 1.07 1.22	P P P	P 1.05 P	P P P
Northwest Industries	(x-1) (x-2) (x-3)	101 82 57	131 108 79	296 290 269	572 554 457	189 171 140	601 585 536	583 504 429	1184 1089 965	29.9 24.9 24.0	P 18.5 14.7	1.03 1.16 1.25	P P P	P P P	P P P
NW Steel & Wire	(x-1) (x-2) (x-3)	27 34 27	34 40 32	56 102 109	121 140 137	19 32 28	65 66 58	173 175 155	238 240 213	P P P	P P P	P P P	P P P	P P P	P P P
Norton Co.	(x-1) (x-2) (x-3)	21 25 21	34 38 33	159 127 115	288 279 235	88 120 80	193 185 141	255 244 228	448 429 369	P P P	18.0 P P	P P P	P P P	P 1.06 P	P P P
Nucor Corporation	(x-1) (x-2) (x-3)	8 10 6	12 13 8	19 26 22	45 45 39	18 24 19	48 45 41	45 37 27	93 82 68	P P P	P P 19.3	1.08 1.21 1.54	P 1.87 1.99	1.07 1.07 1.12	P P P
Oakite Products	(x-1) (x-2) (x-3)	3 3 2	3 3 3	9 9 8	17 17 14	6 7 4	6 8 5	17 16 15	24 24 20	26.7 27.0 29.1	P P P	P P P	P P P	P P P	P P P
Occidental Petroleum	(x-1) (x-2) (x-3)	172 281 72	310 393 214	1015 1048 913	1328 1372 1172	783 907 858	2302 2231 1991	1201 1094 847	3503 3326 2838	P P P	13.5 17.6 10.7	1.92 F F	1.70 1.51 F	P 1.16 1.06	P P 2.5
Olin Corporation	(x-1) (x-2) (x-3)	59 84 61	118 NA NA	305 277 297	531 498 472	221 215 246	478 465 528	536 488 560	1014 953 1088	P P P	P 18.1 11.6	1.08 P P	P P 1.92	P P P	P P P
P&F Industries	(x-1) (x-2) (x-3)	.1 1 -.5	1 3 .6	14 16 15	27 37 26	11 24 15	26 34 26	13 13 12	39 47 38	21.9 F F	F F F	1.97 F F	P 1.51 1.80	P F F	F 3.0 F
Park Chemical	(x-1) (x-2) (x-3)	.5 .5 .3	.6 .6 .4	2 2 1	2 2 2	.5 .8 .6	.6 .8 .6	3 3 2	3 4 3	24.2 22.8 26.7	P P P	P P P	P P P	P P P	P P P
Park Electrochemical	(x-1) (x-2) (x-3)	-.2 1 .6	.5 2 1	5 7 6	9 10 8	4 5 3	5 5 4	10 10 9	14 15 13	P P P	10.8 P P	P P P	P P P	P P P	P P P
Peerless Tube	(x-1) (x-2) (x-3)	.5 .8 .9	1 2 2	3 2 2	5 5 4	2 2 2	3 3 2	10 10 9	13 13 11	P P P	P P P	P P P	P P P	P F F	3.9 P P
Pennwalt	(x-1) (x-2) (x-3)	34 27 20	55 45 37	159 146 125	309 298 247	100 149 90	275 273 216	266 246 222	541 519 438	P P P	19.8 16.3 17.1	1.03 1.11 P	P P P	P P P	P P P

210

TABLE III-4
(continued)

Name of Firm	Year[1/]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2/]	CF/TL[3/]	TL/NW[4/]	CURRAT[5/]	QRAT[6/]	NI/TA[7/]
Pennzoil	(x-1)	107	215	297	445	247	1453	573	2026	P	14.8	F	1.80	1.20	2.7
	(x-2)	128	218	218	338	146	1283	515	1798	P	17.0	F	P	P	P
	(x-3)	84	155	245	323	228	1135	628	1762	P	13.7	1.81	F	1.07	P
Phelps Dodge	(x-1)	71	106	145	336	189	759	893	1652	P	13.9	P	1.78	F	P
	(x-2)	122	158	121	324	231	601	892	1493	P	P	P	F	F	P
	(x-3)	109	145	229	362	145	454	815	1269	P	P	P	P	P	P
Pgh-Des Moines Steel	(x-1)	4	7	62	73	48	56	39	96	20.6	11.7	1.42	1.51	P	P
	(x-2)	2	4	58	73	51	59	36	95	F	F	1.64	F	1.14	2.0
	(x-3)	3	5	49	57	42	43	35	78	20.6	10.9	1.23	F	1.17	3.5
Pittsburgh Forgings	(x-1)	9	12	25	52	26	42	42	84	F	P	1.00	P	F	P
	(x-2)	3	6	24	52	31	42	36	78	F	13.8	1.18	1.68	F	3.5
	(x-3)	2	5	16	37	18	30	32	62	F	18.2	P	P	F	3.9
Plant Industries	(x-1)	2	5	11	20	19	33	16	48	P	15.1	F	F	F	P
	(x-2)	1	4	10	18	16	28	16	44	P	12.4	1.81	F	F	3.2
	(x-3)	1	3	8	16	11	20	16	36	P	13.5	1.28	F	F	3.1
Portec	(x-1)	6	7	18	41	11	22	35	56	25.3	P	P	P	P	P
	(x-2)	5	6	17	44	18	28	29	57	21.1	P	P	P	F	P
	(x-3)	2	4	8	27	10	19	24	43	27.9	18.9	P	P	F	P
Redman Industries	(x-1)	-23	-22	22	33	20	89	11	100	F	F	F	1.68	1.11	F
	(x-2)	-24	-22	22	33	20	89	11	101	F	F	F	1.65	1.10	F
	(x-3)	-15	-13	31	45	39	110	35	146	F	F	F	F	F	F
Republic Steel	(x-1)	72	157	282	614	269	792	1279	2071	P	19.8	P	P	1.05	3.5
	(x-2)	171	252	502	759	409	810	1232	2042	P	P	P	1.86	P	P
	(x-3)	87	166	352	613	333	755	1107	1862	P	P	P	1.84	1.06	P
Revere Copper & Brass	(x-1)	-31	-15	64	189	88	321	137	458	P	F	F	P	F	F
	(x-2)	17	34	61	194	83	329	170	499	P	10.4	1.94	P	F	3.4
	(x-3)	3	19	84	173	84	333	153	486	P	F	F	P	1.01	F
Reynolds Metals	(x-1)	60	133	294	845	292	1373	831	2204	P	F	1.65	P	1.01	P
	(x-2)	111	188	399	902	340	1525	799	2324	P	12.3	1.91	P	1.17	P
	(x-3)	45	120	221	717	250	1409	709	2118	P	F	1.99	P	P	2.1
Roblin Industries	(x-1)	2	5	21	31	13	36	18	54	28.0	12.8	1.97	P	P	P
	(x-2)	5	7	20	32	14	38	17	55	28.3	17.2	F	P	P	P
	(x-3)	-3	-2	21	37	18	49	13	61	26.0	F	F	1.99	1.14	F
Rusco Industries	(x-1)	.4	1	9	21	9	22	7	30	24.3	F	F	P	1.02	F
	(x-2)	.2	1	10	22	9	24	7	32	24.1	F	F	P	1.07	F
	(x-3)	.9	2	10	19	9	22	7	29	26.2	F	F	P	1.05	3.1
Season-All Industries	(x-1)	.8	1	4	8	4	6	6	12	P	20.0	1.05	P	1.11	P
	(x-2)	.8	1	3	7	3	6	5	12	P	16.7	1.21	P	F	P
	(x-3)	.6	1	3	6	3	5	5	10	P	19.6	1.11	1.84	F	P

211

Reproduced from
best available copy.

TABLE III-4
(continued)

Name of Firm	Year1/	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA2/	CF/TL3/	TL/NW4/	CURRAT5/	QRAT6/	NI/TA7/
Sharon Steel	(x-1)	15	25	89	146	56	96	182	278	P	P	P	P	P	P
	(x-2)	47	58	140	189	86	137	171	308	P	P	P	P	P	P
	(x-3)	12	22	62	104	49	89	127	216	P	P	P	P	P	P
Signal Companies	(x-1)	1	78	485	1149	443	1058	808	1866	21.5	F	1.31	P	1.09	2.2
	(x-2)	176	201	464	1038	403	747	786	1533	F	P	P	P	1.15	P
	(x-3)	59	80	254	684	273	672	686	1358	F	11.9	P	P	F	P
Signode Corporation	(x-1)	17	32	70	157	39	99	174	273	P	P	P	P	P	P
	(x-2)	24	39	69	165	54	115	164	279	27.8	P	P	P	P	P
	(x-3)	22	35	75	127	39	100	146	247	27.2	P	P	P	P	P
St. Joe Minerals	(x-1)	82	113	126	200	107	195	361	556	P	P	P	1.87	1.18	P
	(x-2)	89	113	146	190	119	197	299	496	P	P	P	1.60	P	P
	(x-3)	38	56	82	112	65	151	229	380	P	P	P	1.72	P	P
Standard Alliance	(x-1)	2	2	10	20	10	19	14	33	22.7	F	1.38	1.99	F	P
	(x-2)	3	3	13	25	12	22	13	35	F	11.2	1.76	1.99	1.01	P
	(x-3)	2	2	12	22	11	21	11	32	F	11.3	1.99	P	1.10	P
Std. Pressed Steel	(x-1)	2	8	26	80	27	56	75	131	P	13.8	P	P	F	F
	(x-2)	12	16	37	98	43	71	75	146	P	P	P	P	F	P
	(x-3)	7	12	27	72	34	54	66	120	P	P	P	P	F	P
Sunbeam Corporation	(x-1)	23	38	199	466	213	340	267	607	F	11.2	1.27	P	F	3.8
	(x-2)	31	45	188	398	198	272	256	528	F	16.4	1.06	P	F	P
	(x-3)	28	41	152	322	126	207	237	444	F	19.7	P	P	P	P
Sunshine Mining	(x-1)	4	5	26	36	9	31	27	58	21.8	16.8	1.15	P	P	P
	(x-2)	5	6	21	36	11	34	25	59	20.8	17.9	1.33	P	P	P
	(x-3)	3	4	24	32	9	30	23	53	20.4	14.1	1.28	P	P	P
Synalloy	(x-1)	3	3	9	20	6	12	17	30	22.3	P	P	P	P	P
	(x-2)	2	2	8	20	8	15	15	30	22.7	15.4	P	P	1.04	P
	(x-3)	.9	2	6	16	5	13	14	26	26.5	13.6	P	P	P	P
Tennessee Forging	(x-1)	1	2	7	17	8	29	13	42	P	F	F	P	F	3.1
	(x-2)	4	.6	9	17	13	24	11	35	P	P	F	F	F	P
	(x-3)	1	2	4	7	6	13	5	18	P	15.3	F	F	F	P
Texasgulf	(x-1)	103	129	118	291	105	527	628	1155	P	P	P	P	1.12	P
	(x-2)	147	188	229	327	142	417	560	977	P	P	P	P	P	P
	(x-3)	74	109	103	182	68	336	440	776	P	P	P	P	P	P
U.S. Reduction Company	(x-1)	8	10	14	28	16	19	25	44	P	P	P	1.78	F	P
	(x-2)	8	10	22	34	23	29	17	46	2.52	P	1.69	F	F	P
	(x-3)	1	3	8	18	12	19	9	28	P	13.5	F	F	F	P
Utah International	(x-1)	12	160	118	193	176	505	541	1046	P	P	P	F	F	P
	(x-2)	97	135	80	132	118	461	448	909	P	P	1.03	F	F	P
	(x-3)	55	91	60	110	84	428	380	828	P	P	1.13	F	F	P

TABLE III-4
(concluded)

Name of Firm	Year[1]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2]	CF/TL[3]	TL/NW[4]	CURRAT[5]	QRAT[6]	NI/TA[7]
Valley Industries	(x-1)	15	16	20	54	18	22	43	66	F	P	1.95	P	1.12	P
	(x-2)	25	26	53	71	49	54	27	81	F	P	1.97	F	1.08	P
	(x-3)	5	6	17	31	16	26	14	40	21.1	P	1.82	1.98	1.11	P
Van Dorn Company	(x-1)	3	6	21	46	12	38	32	69	P	14.9	1.18	P	P	4.0
	(x-2)	4	7	13	43	12	36	30	66	P	18.9	1.20	P	1.12	P
	(x-3)	4	6	24	46	16	40	27	68	P	16.0	1.48	P	P	P
Vulcan Materials	(x-1)	28	51	73	120	40	153	173	326	P	P	P	P	P	P
	(x-2)	30	60	61	105	52	120	157	277	P	P	P	P	1.17	P
	(x-3)	23	42	63	93	39	96	143	239	P	P	P	P	P	P
Washington Steel	(x-1)	3	3	11	26	9	27	35	62	P	12.5	P	P	1.18	P
	(x-2)	6	6	13	26	11	19	33	52	P	P	P	P	1.20	P
	(x-3)	4	4	14	26	8	15	29	44	P	P	P	P	P	P
Wheeling-Pittsburgh	(x-1)	.6	31	148	258	116	311	365	676	P	F	P	P	P	F
	(x-2)	73	102	223	347	199	351	371	722	P	P	P	1.74	1.12	P
	(x-3)	7	37	133	258	123	304	302	606	P	12.1	1.01	P	1.08	F
Youngstown Steel Door	(x-1)	1	2	11	20	6	14	24	38	P	15.6	P	P	P	2.6
	(x-2)	3	4	10	23	8	17	24	41	P	P	P	P	P	P
	(x-3)	2	3	11	20	6	15	23	37	P	19.9	P	P	P	P

213

TABLE III-5

FINANCIAL DATA FOR FIRMS IN THE HOLDOUT BANKRUPT SAMPLE

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1]	CF/TL[2]	TL/NW[3]	CURRAT[4]	QRAT[5]
Acme-Hamilton Mfg.	1977(x-1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1976(x-2)	-0.9	-0.4	5.1	11.2	9.0	15.3	4.3	19.6	P	F	F	F	F
	1975(x-3)	0.1	0.5	4.0	10.4	7.3	13.0	5.2	18.2	P	F	F	F	F
Aerodex	1975(x-1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1974(x-2)	.006	0.6	2.5	8.8	6.5	13.4	0.9	14.3	F	F	F	F	F
	1973(x-3)	0.3	1.0	5.2	11.2	7.8	15.8	0.8	16.6	22.9	F	F	F	F
AIM Companies	1970(x-1)	-2.9	NA	4.1	13.4	9.6	19.6	6.9	26.5	21.7	NA	F	F	F
	1969(x-2)	1.3	2.1	4.6	8.5	4.0	10.6	7.6	18.2	25.6	19.8	1.39	P	1.15
	1968(x-3)	-1.1	-0.6	4.5	8.5	4.5	14.2	6.4	20.6	24.8	F	F	1.89	1.00
Capehart Corporation	1974(x-1)	-4.0	-2.7	14.5	41.0	43.1	33.9	7.1	41.0	F	F	F	F	F
	1973(x-2)	3.2	3.9	15.2	39.0	32.9	39.3	11.1	50.4	F	F	F	F	F
	1972(x-3)	1.8	2.3	8.6	14.1	7.9	10.1	7.9	18.0	F	P	1.28	1.78	1.09
Commodore Corporation	1973(x-1)	1.1	1.9	17.0	26.6	21.4	37.1	9.8	46.9	F	F	F	F	F
	1972(x-2)	0.8	1.6	13.6	20.4	14.2	29.9	8.6	38.5	F	F	F	F	F
	1971(x-3)	-3.0	-2.2	9.3	17.3	12.0	27.0	9.4	36.4	F	F	F	F	F
Commonwealth Oil Refining	1977(x-1)	-18.0	-6.1	129.0	232.6	401.9	409.1	127.5	536.6	P	F	F	F	F
	1976(x-2)	-32.1	-19.8	110.0	248.2	221.2	420.9	145.2	566.1	P	F	F	F	F
	1975(x-3)	-24.2	-13.3	151.0	252.6	208.5	394.2	179.3	573.5	P	F	F	F	F
Dynamics Corporation	1971(x-1)	-6.3	-4.3	43.3	63.7	39.8	29.9	50.0	79.9	F	F	P	1.60	1.09
	1970(x-2)	-9.9	-7.4	51.1	80.9	51.7	26.7	73.9	100.6	F	F	P	1.56	F
	1969(x-3)	2.3	4.3	51.6	82.0	40.9	63.7	37.1	100.8	F	F	1.72	P	1.26
Ecological Science	1969(x-1)	2.8	3.6	18.4	26.8	16.9	66.1	22.7	88.8	P	F	F	1.59	1.09
	1968(x-2)	2.5	3.0	13.5	18.1	7.9	37.6	16.2	53.8	P	F	F	P	P
	1967(x-3)	0	0.3	3.1	3.5	1.2	20.6	7.3	27.9	P	F	F	P	P
Elcor Chemical	1970(x-1)	-39.5	-38.6	2.9	2.9	11.4	43.5	-32.0	11.5	P	F	F	F	F
	1969(x-2)	-8.8	-7.4	6.7	8.2	11.6	53.9	6.5	60.4	P	F	F	F	F
	1968(x-3)	-4.7	NA	9.7	11.5	12.4	62.7	3.9	66.6	P	NA	F	F	F
Electrospace	1972(x-1)	1.8	4.0	NA	33.9	19.4	30.5	13.8	44.3	F	13.1	F	1.75	F
	1971(x-2)	2.0	2.5	11.1	30.1	18.3	29.7	11.9	41.6	F	F	F	1.64	F
	1970(x-3)	0.9	1.2	8.1	27.1	15.8	27.0	10.1	37.1	F	F	F	1.72	F
FDI, Inc.	1977(x-1)	1.6	3.6	23.7	36.3	14.0	44.2	10.8	55.0	F	F	F	P	P
	1976(x-2)	0.8	2.9	21.8	31.7	12.7	40.3	10.4	50.7	F	F	F	P	P
	1975(x-3)	-8.7	-7.8	21.2	33.8	15.9	44.4	9.8	54.2	20.7	F	F	P	P
Garcia Corporation	1977(x-1)	-10.0	-7.6	28.5	61.9	55.7	68.7	12.1	80.8	F	F	F	F	F
	1977(x-2)	-4.5	-2.4	33.0	61.0	46.5	59.8	22.1	81.9	F	F	F	F	F
	1975(x-3)	0.3	2.2	40.4	75.7	60.0	68.6	26.7	95.3	F	F	F	F	F

[1] P > 30.0 (passes all tests); F < 20.0 (fails all tests)
[2] P > 20.0 (passes all tests); F < 10.0 (fails all tests)
[3] P < 1.0 (passes all tests); F > 2.0 (fails all tests)
[4] P > 2.0 (passes all tests); F < 1.5 (fails all tests)
[5] P > 1.2 (passes all tests); F < 1.0 (fails all tests)

TABLE III-5
(concluded)

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1]	CF/TL[2]	TL/NW[3]	CURRAT[4]	QRAT[5]
GRT Corporation	1978(x-1) 1977(x-2) 1976(x-3)	0 1.5 -0.7	.8 2.2 -0.1	14.1 14.4 11.2	18.7 18.3 13.5	15.6 14.7 11.5	18.2 16.4 13.9	5.6 6.1 2.9	23.8 22.5 16.9	F F F	F F F	F F F	F F F	F F F
Leisure Group, Inc.	1970(x-1) 1969(x-2) 1968(x-3)	-31.4 0.2 1.7	-29.8 1.0 2.3	23.4 31.9 17.9	32.6 51.0 30.6	26.7 39.4 21.2	40.9 58.9 39.0	17.9 33.2 14.0	58.8 92.1 53.0	F F F	F F F	F 1.77 F	F F F	F F F
Meister Brau	1970(x-1) 1969(x-2) 1968(x-3)	-1.9 0.1 0.2	-0.7 1.0 1.1	4.1 4.3 2.7	9.2 8.3 5.4	9.0 6.0 2.9	25.8 16.1 12.9	6.1 8.2 7.5	31.9 24.3 20.4	P P P	F F F	F 1.96 1.72	F F 1.86	F F F
Potter Instruments	1974(x-1) 1973(x-2) 1972(x-3)	-11.4 -2.2 -13.1	NA 3.4 -8.6	7.3 10.6 10.3	25.1 36.2 32.5	36.3 27.2 17.9	39.3 44.3 39.1	4.5 15.9 18.2	43.8 60.2 57.3	F P P	NA F F	F F F	F F 1.82	F F F
R. Hoe	1968(x-1) 1967(x-2) 1966(x-3)	2.0 2.4 1.3	2.9 3.0 1.7	22.9 18.3 12.3	32.3 24.9 17.1	26.1 15.4 12.1	30.6 18.1 14.1	22.6 18.5 11.8	53.2 36.6 25.9	24.2 23.4 25.1	F 16.6 12.1	1.35 P 1.19	F 1.62 F	F 1.19 1.02
Sitkin	1977(x-1) 1976(x-2) 1975(x-3)	-0.3 -0.9 0.1	0.2 -0.5 0.5	7.6 5.2 11.4	18.4 14.0 20.1	15.4 11.1 15.3	16.8 13.1 19.1	4.4 5.2 5.1	21.2 18.3 24.2	F F F	F F F	F F F	F F F	F F F
THA Co.	1970(x-1) 1969(x-2) 1968(x-3)	-1.3 -1.7 -0.1	-1.2 -1.6 0	0.7 1.2 2.3	3.2 5.5 5.1	1.2 1.8 1.4	2.8 3.5 3.6	0.7 2.4 2.2	3.5 5.9 5.8	F F F	F F F	F 1.46 1.64	P P P	F F P
Transogram	1970(x-1) 1969(x-2) 1968(x-3)	NA 0.2 -3.2	NA 0.5 -3.0	NA 7.4 5.7	NA 12.1 9.7	NA 8.2 7.6	NA 16.7 10.2	NA 4.8 1.5	NA 21.5 11.7	NA 24.3 F	NA F F	NA F F	NA F F	NA F F
Wilcox-Gibbs	1976(x-1) 1975(x-2) 1974(x-3)	NA -11.5 -1.5	NA -10.8 -0.9	NA 10.7 16.3	NA 42.4 48.6	NA 17.3 28.6	NA 51.4 41.7	NA 8.1 20.0	NA 59.5 61.7	NA F F	NA F F	NA F F	NA F 1.70	NA F F
Roberts Company	1969(x-1) 1968(x-2) 1967(x-3)	NA 0.5 1.5	NA 1.3 2.4	NA 11.8 6.9	NA 23.4 16.7	NA 15.3 10.6	NA 24.6 20.3	NA 12.2 7.6	NA 36.8 27.9	NA 23.9 29.7	NA F 11.8	NA F F	NA 1.53 1.58	NA F F
Steiber	1975(x-1) 1974(x-2) 1973(x-3)	NA -13.2 2.3	NA -10.5 NA	NA 18.5 15.0	NA 50.0 45.6	NA 67.1 36.5	NA 72.1 53.5	NA 6.3 14.8	NA 78.4 68.3	NA 24.8 26.8	NA F F	NA F F	NA F F	NA F F
Piedmont Industries	1978(x-1) 1977(x-2) 1976(x-3)	0.4 -0.1 1.0	0.8 0.3 1.4	3.5 2.6 2.6	13.9 12.1 12.2	7.1 4.9 4.5	10.3 6.7 8.7	6.4 8.0 6.1	16.7 14.7 14.8	F F F	F F 16.1	1.61 P 1.43	1.96 P P	F F F

215

TABLE III-6

Reproduced from best available copy.

FINANCIAL DATA FOR FIRMS IN THE HOLDOUT NON-BANKRUPT SAMPLE

Name of Firm	Year[1]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2]	CF/TL[3]	TL/NW[4]	CURRAT[5]	QRAT[6]
Adams Millis Corp.	x-1	1.7	3.8	10.0	20.3	8.8	16.6	19.0	35.4	P	P	P	P	P
	x-2	-5.9	-3.6	7.1	19.8	7.8	24.0	17.0	41.1	P	F	1.41	P	F
	x-3	1.3	3.5	11.2	24.8	8.3	26.5	23.0	49.8	P	11.5	1.15	P	P
Air Products & Chemicals	x-1	54.2	107.6	171.0	248.0	193.0	475.0	301.0	776.0	P	P	1.58	F	F
	x-2	39.7	85.5	168.0	223.0	162.0	411.0	248.0	659.0	P	P	1.66	F	1.04
	x-3	24.1	61.6	111.0	144.0	106.0	309.0	211.0	520.0	P	19.9	1.46	F	1.05
Akzona	x-1	7.9	41.3	124.0	265.0	94.0	341.0	315.0	656.0	P	12.1	1.08	P	P
	x-2	33.4	63.4	99.0	258.0	80.0	301.0	323.0	624.0	P	P	P	P	P
	x-3	35.7	63.6	118.0	228.0	87.0	264.0	304.0	568.0	P	P	P	P	P
Amerace	x-1	8.1	15.5	44.0	101.2	49.3	92.6	90.0	182.6	P	16.7	1.03	P	F
	x-2	13.5	20.3	40.7	93.5	35.4	79.1	86.8	165.9	P	P	P	P	1.15
	x-3	9.8	16.7	44.3	88.1	33.2	75.2	84.8	160.0	P	P	P	P	P
American Petrofina	x-1	40.2	71.3	177.0	282.0	155.0	238.0	364.0	602.0	P	P	P	1.82	1.14
	x-2	86.7	117.2	170.0	280.0	148.0	230.0	345.0	575.0	P	P	P	1.89	1.15
	x-3	37.0	56.2	118.0	172.0	100.0	175.0	276.0	451.0	P	P	P	1.72	1.18
Atlas Corp.	x-1	3.0	4.8	12.9	27.8	21.2	25.6	27.2	52.8	P	18.8	P	F	F
	x-2	1.6	3.1	12.7	26.5	17.6	22.1	24.3	46.4	P	14.0	P	1.51	F
	x-3	-2.4	-0.8	9.5	20.8	11.8	16.0	23.1	39.1	P	F	P	1.76	F
Avondale Mills	x-1	4.0	11.8	40.0	66.8	32.9	35.4	74.5	109.9	P	P	P	P	P
	x-2	6.3	14.2	49.8	74.2	41.6	43.8	74.3	118.1	P	32.4	P	1.79	1.20
	x-3	8.1	16.0	38.4	65.7	33.8	36.0	70.3	106.3	P	P	P	1.94	1.14
Ball Corporation	x-1	14.1	23.3	58.6	129.6	71.5	122.3	102.8	225.1	P	19.0	1.19	1.81	F
	x-2	9.5	18.2	40.6	105.1	54.1	89.4	91.7	181.1	P	20.4	P	1.94	F
	x-3	7.2	NA	35.7	75.1	33.4	64.8	84.8	149.6	P	11.1	P	P	1.07
Belding-Heminway	x-1	3.2	5.1	20.2	45.9	14.0	29.0	33.1	62.1	20.7	17.6	P	P	P
	x-2	2.8	4.7	15.1	42.9	13.4	29.4	30.8	60.2	22.5	16.0	P	P	1.13
	x-3	2.5	4.2	18.0	41.0	17.2	29.7	29.4	59.1	25.3	P	1.01	P	1.05
Borg Warner	x-1	44.5	87.3	253.0	590.0	244.0	504.0	689.0	1193.0	P	17.3	P	P	1.04
	x-2	50.8	93.9	245.0	688.0	264.0	615.0	670.0	1285.0	P	15.3	P	P	F
	x-3	71.3	111.8	271.0	642.0	291.0	530.0	642.0	1172.0	P	P	P	P	F
Buehler Corporation	x-1	0.7	1.5	3.5	11.8	4.0	10.5	5.3	15.8	23.0	14.3	1.98	P	F
	x-2	1.1	1.9	4.5	12.7	5.1	12.3	4.6	16.9	22.0	15.4	F	P	F
	x-3	0.9	1.7	4.5	9.6	5.4	10.4	3.5	13.9	26.0	16.3	F	1.78	F

[1] For all firms, x-1 is 1975, x-2 is 1974, and x-3 is 1973.

[2] P > 30.0 (passes all tests); F < 20.0 (fails all tests)

[3] P > 20.0 (passes all tests); F < 10.0 (fails all tests)

[4] P < 1.0 (passes all tests); F > 2.0 (fails all tests)

[5] P > 2.0 (passes all tests); F < 1.5 (fails all tests)

[6] P > 1.2 (passes all tests); F < 1.0 (fails all tests)

216

TABLE III-6
(continued)

Name of Firm	Year[1/]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2/]	CF/TL[3/]	TL/NW[4/]	CURRAT[5/]	QRAT[6/]
Burlington	x-1	39.8	132.9	485.0	853.0	237.0	671.0	895.0	1566.0	P	19.8	P	P	P
	x-2	99.5	191.7	496.0	932.0	319.0	757.0	887.0	1644.0	P	25.1	P	P	P
	x-3	82.4	173.1	459.0	880.0	293.0	756.0	825.0	1581.0	P	22.9	P	P	P
Carter Wallace	x-1	8.4	11.1	52.7	83.0	20.5	30.9	124.3	155.2	F	P	P	P	P
	x-2	3.1	5.6	71.5	94.0	25.3	19.9	119.0	138.9	20.9	P	P	P	P
	x-3	10.4	12.5	68.7	99.0	24.7	22.5	118.7	141.2	F	P	P	P	P
Chemetron	x-1	30.4	46.9	99.0	190.2	54.0	161.9	209.4	371.3	P	P	P	P	P
	x-2	22.3	38.1	92.1	173.5	60.1	158.6	183.6	342.2	P	P	P	P	P
	x-3	10.4	26.1	68.5	146.3	55.4	141.4	167.4	308.8	P	18.4	P	P	P
Clark Oil	x-1	5.2	19.1	60.0	120.7	95.3	208.3	100.5	308.8	P	F	F	F	F
	x-2	-7.1	6.1	76.7	141.1	123.6	202.9	98.8	301.7	P	F	F	F	F
	x-3	30.5	43.2	84.4	143.4	101.5	253.5	109.5	263.0	P	17.0	F	F	F
Colt Industries	x-1	52.1	79.8	205.0	497.0	187.0	491.0	375.0	866.0	P	16.3	1.31	P	1.10
	x-2	77.3	103.8	227.0	497.0	172.0	438.0	340.0	778.0	P	P	1.29	P	P
	x-3	26.7	52.2	205.0	422.0	139.0	396.0	275.0	671.0	P	13.2	1.44	P	P
Conchemco	x-1	0.3	1.3	11.1	19.3	6.8	12.3	22.5	34.8	P	F	P	P	P
	x-2	1.8	2.7	11.1	26.0	11.4	19.5	22.5	42.0	27.1	13.8	P	P	F
	x-3	1.8	2.6	10.5	21.1	7.2	15.0	21.2	36.2	29.0	17.3	P	P	P
Cone Mills Corp.	x-1	24.2	37.8	73.5	162.2	51.5	96.0	177.5	273.5	P	P	P	P	P
	x-2	15.3	27.3	78.7	163.3	65.5	95.5	156.4	241.9	P	P	P	P	P
	x-3	9.7	21.6	81.9	162.3	67.9	102.8	145.6	248.4	P	21.0	P	P	P
Crompton Co.	x-1	-2.6	1.5	29.1	43.7	24.2	51.9	38.9	90.8	P	F	1.33	1.81	P
	x-2	0.1	2.5	22.6	34.9	11.8	42.1	41.5	83.6	P	F	1.01	P	P
	x-3	5.8	7.9	26.4	33.8	12.5	21.4	42.7	64.1	P	P	P	P	P
Crown Central	x-1	5.5	13.0	50.6	82.7	79.0	134.6	71.7	206.3	P	F	1.88	F	F
	x-2	10.2	16.6	50.0	76.9	69.1	112.2	66.2	178.4	P	14.8	1.69	F	F
	x-3	8.4	14.4	38.3	63.1	47.2	91.2	57.0	148.2	P	15.8	1.60	F	F
Dahlstrom Corporation	x-1	0.9	1.5	4.5	9.5	6.5	14.5	6.9	21.4	P	10.3	F	F	F
	x-2	1.8	2.2	3.5	6.0	2.8	7.6	6.0	13.6	P	P	1.27	P	P
	x-3	-4.1	-3.5	5.4	9.1	5.5	12.5	4.2	16.7	P	F	F	1.65	F
Damon Corporation	x-1	1.8	4.5	52.3	73.3	20.5	44.0	62.5	106.5	25.1	10.2	P	P	P
	x-2	8.1	10.7	59.0	81.0	25.3	48.9	61.8	110.7	22.4	P	P	P	P
	x-3	9.7	11.9	55.5	72.1	24.7	49.4	52.7	102.1	24.4	P	P	P	P
Daniel Industries	x-1	4.4	5.2	13.0	32.6	16.6	22.5	21.9	44.4	25.5	P	1.03	1.96	F
	x-2	3.0	3.6	9.6	23.9	11.4	15.6	16.9	32.5	26.2	P	P	P	F
	x-3	1.3	1.9	7.8	16.7	8.5	9.6	14.3	23.9	29.3	19.8	P	1.96	F
Dan River Inc.	x-1	-2.9	11.0	89.4	188.7	57.2	163.6	144.0	308.0	P	6.7	1.13	F	F
	x-2	7.0	19.7	79.2	198.7	76.9	166.9	148.0	315.0	P	11.8	1.13	F	F
	x-3	10.4	22.1	88.3	210.4	73.3	165.6	144.0	310.0	P	13.3	1.15	F	F

TABLE III-6
(continued)

Name of Firm	Year[1/]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2/]	CF/TL[3/]	TL/NW[4]	CURRAT[5]	QRAT[6/]
De Soto, Inc.	x-1 x-2 x-3	2.8 0.6 8.3	9.2 6.5 13.9	32.3 32.0 31.3	75.4 87.5 97.0	51.7 62.2 62.4	64.9 75.7 74.8	70.1 69.2 72.0	135.0 144.9 146.8	P P P	14.2 F 18.6	P 1.09 1.04	F F 1.55	F F F
Diversa	x-1 x-2 x-3	4.0 3.6 2.5	6.4 5.5 4.1	23.4 18.7 16.0	35.6 32.2 24.6	21.5 21.9 14.5	33.3 31.2 23.0	22.6 19.5 16.7	55.9 50.7 39.7	24.5 23.5 22.4	19.2 17.6 17.8	1.47 1.6 1.38	1.66 F 1.7	1.09 F 1.1
Eagle-Picher	x-1 x-2 x-3	18.7 18.0 14.8	27.8 27.2 23.4	74.9 60.0 57.1	131.1 129.0 111.2	41.5 46.7 38.4	81.8 88.5 81.0	136.9 124.0 111.1	218.7 212.5 192.1	P P P	P P P	P P P	P P P	P P P
Elcor Chemical Corp.	x-1 x-2 x-3	5.2 2.5 0.4	6.1 3.1 0.8	15.9 9.3 12.0	16.7 10.0 12.3	9.2 7.0 10.4	14.7 14.2 21.7	12.2 7.0 4.6	26.9 21.2 26.3	P 23.3 22.8	P P F	1.21 F F	1.82 F F	P F F
Emery Industries	x-1 x-2 x-3	10.7 10.2 7.0	15.2 14.7 11.1	35.8 30.5 26.7	61.8 52.1 45.7	23.6 21.2 13.7	61.4 49.1 40.8	81.7 74.3 67.4	143.1 123.4 108.2	P P P	P P P	P P P	P P P	P P P
Ethyl Corp.	x-1 x-2 x-3	61.0 74.3 52.9	103.3 113.1 85.3	246.0 179.0 274.0	371.0 328.0 365.0	105.0 128.0 95.0	440.0 383.0 348.0	436.0 400.0 348.0	876.0 783.0 691.0	P P P	P P P	1.01 P 1.00	P P P	P P P
Fab Ind.	x-1 x-2 x-3	2.1 0.9 1.9	3.3 2.0 3.0	15.2 9.9 10.5	24.7 20.5 19.7	24.7 6.2 6.5	10.2 11.7 11.9	14.6 17.8 17.2	19.8 29.5 29.1	P P P	32.4 17.1 P	P P P	P P P	P P P
Fairmont Chemical	x-1 x-2 x-3	0.3 1.1 0.2	0.5 1.3 0.5	1.4 2.6 1.3	2.9 4.2 2.4	0.5 1.8 0.7	0.7 2.1 1.1	4.0 3.8 2.8	4.7 5.9 3.9	27.6 20.3 P	P P P	P P P	P P P	P P P
Ferro	x-1 x-2 x-3	15.2 19.9 15.9	21.8 25.9 21.1	84.7 77.3 73.3	139.8 147.3 121.6	54.7 69.9 54.1	88.0 101.4 86.1	126.3 115.1 99.4	212.3 216.5 185.5	29.9 27.6 28.8	P P P	P P P	P P P	P 1.11 P
Filtrol	x-1 x-2 x-3	5.5 4.4 3.1	7.6 5.6 3.6	17.6 13.6 22.0	26.0 20.0 25.2	9.9 6.2 5.0	28.6 24.4 5.0	31.8 27.9 26.1	60.4 52.3 31.1	P P P	P P P	P P P	P P P	P P P
Foote Mineral Co.	x-1 x-2 x-3	9.8 11.3 2.8	14.8 15.6 6.9	18.7 26.7 24.0	49.8 45.2 45.0	15.8 21.3 19.1	52.4 26.7 29.5	74.4 67.2 58.7	126.8 93.9 88.2	P P P	P P P	P P P	P P P	1.18 P P
Forest Laboratories	x-1 x-2 x-3	0.7 -4.8 -1.0	0.8 -4.6 -0.5	2.9 4.1 5.1	4.5 5.4 6.4	0.7 2.5 2.3	0.8 2.6 2.5	5.2 4.4 9.1	6.0 7.0 11.6	F F F	P F F	P P P	P P P	P P P

218

219

TABLE III-6
(concluded)

Name of Firm	Year[1]	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[2]	CF/TL[3]	TL/NW[4]	CURRAT[5]	QRAT[6]
Gulf Resources & Chemical	x-1	28.7	40.7	80.6	135.9	63.1	158.9	118.4	277.3	P	P	1.34	P	P
	x-2	36.2	43.7	79.0	111.0	46.6	142.3	76.1	218.4	P	P	1.87	P	P
	x-3	7.4	12.7	36.9	63.4	24.3	102.6	41.7	144.3	P	12.4	F	P	P
Handy & Harman	x-1	12.7	15.7	56.6	111.5	59.6	90.1	56.4	146.5	21.6	17.4	1.60	1.87	F
	x-2	12.2	14.8	54.5	127.0	82.0	111.9	45.4	157.2	F	13.2	F	1.55	F
	x-3	5.4	7.8	50.1	100.7	72.0	92.4	35.1	127.5	F	F	F	F	F
Hunt Chemical Corp.	x-1	3.6	NA	19.0	28.9	6.5	6.5	38.7	45.2	P	P	P	P	P
	x-2	6.1	NA	18.0	26.9	6.9	6.9	36.7	43.6	P	P	P	P	P
	x-3	6.1	NA	15.2	24.4	5.6	5.6	32.1	37.7	P	P	P	P	P
Hydrometals, Inc.	x-1	3.4	4.8	14.4	50.2	14.3	28.1	33.2	61.3	F	17.1	P	P	1.01
	x-2	3.7	5.2	12.8	52.2	18.7	34.1	29.7	63.8	F	15.2	1.15	P	F
	x-3	3.0	4.5	15.3	45.8	13.8	30.0	26.5	56.5	F	15.0	1.13	P	1.11
Jim Walter	x-1	69.3	98.4	618.0	833.0	519.0	875.0	432.0	1309.0	P	11.2	F	1.60	1.19
	x-2	62.9	88.6	618.0	824.0	627.0	862.0	398.0	1260.0	P	10.3	F	F	F
	x-3	53.6	76.2	528.0	693.0	498.0	731.0	351.0	1082.0	P	10.4	F	F	1.06
Youngstown Sheet & Tube	x-1	40.9	105.2	208.0	471.0	250.0	546.0	713.0	1259.0	P	19.3	P	1.88	F
	x-2	96.4	156.8	339.0	520.0	304.0	560.0	692.0	1252.0	P	P	P	1.71	1.12
	x-3	43.3	97.9	251.0	399.0	198.0	561.0	664.0	1125.0	P	17.4	P	P	P

IV. EVALUATION CRITERIA AND DEVELOPMENT OF RATIO TESTS

All test alternatives were initially evaluated against both the primary non-bankrupt and bankrupt samples. In this evaluation the Agency assumed that a firm would have to meet the financial criteria required by a test for its most recent fiscal year in order to pass the test (i.e., a one-year eligibility requirement). The seven financial ratios selected for detailed analysis were first individually tested; for each ratio examined several different pass-fail cutoff points were investigated. The most promising individual ratio tests were then combined into a series of 120 two-ratio tests (a firm must pass both ratio elements to pass), three-ratio tests (a firm must pass all ratio elements to pass), and contingent three-ratio tests (a firm must pass two of three ratio elements to pass).

To further validate whether these tests represent the most effective indicators of future firm viability, the Agency performed a supplementary analysis. Other financial variables identified in the preliminary literature review but not included in the set of 120 tests were evaluated against a subset of 32 non-bankrupt and 12 bankrupt firms from the primary sample that had proven particularly difficult to classify. The ratio that performed best in this supplementary analysis, net fixed assets/total assets, was then combined with the other candidate financial ratios, and 31 additional three- and four-ratio tests were evaluated.

All ratio tests were examined with two variants: a one-year eligibility requirement and a three-year eligibility requirement. The former

220

requires that a firm meet the requirements of a financial test based on its most recent annual report in order to pass the test. The latter requires that a firm meet the requirements of a financial test based on its three most recent annual reports in order to pass the test.

A. Evaluation Criteria

Five evaluation criteria have been developed to assist the Agency in comparing the test results. These measures are defined and described below.

(1) A_{NB} represents the percentage of sampled non-bankrupt firms that pass a given test. For tests with a one-year eligibility requirement, A_{NB} is measured as the percentage of firms in the non-bankrupt firm sample which passed the test in the year 1975. For tests with a three-year eligibility requirement, A_{NB} is measured as the percentage of firms in the non-bankrupt firm sample which passed the test for all of the years 1973-1975.

Because the non-bankrupt firm sample created for this analysis is composed of companies from industry categories which are most likely to have on-site treatment, storage and/or disposal facilities requiring financial assurance, and contains a representative sample of firms from all size classes, the Agency believes that the A_{NB} results can be used as a reasonable surrogate measure of the overall percentage of viable firms that would be able to pass a financial test. Therefore, tests which have a very low A_{NB} will generate large private sector expenditures, because many viable firms will be required to establish alternative forms of financial assurance. Alternatively, tests with a high A_{NB} will result in low private costs of complying with RCRA.

(2) M represents the percentage of sampled bankrupt firms which would fail a given financial test with insufficient time remaining prior to bankruptcy to ensure that alternative financial mechanisms are available for facility closure, post-closure, and liability requirements.

Because firms in financial distress often suffer a rapid deterioration in their liquid assets in the two to three years prior to bankruptcy, and because of possible delays in enforcement and litigation, the Agency has concluded that a one-year lead time would not be sufficient to guarantee that sufficient funds would be available to cover the costs of closure, post-closure, and liability requirements. Three different assumptions as to what constituted "sufficient lead time" were analyzed by the Agency:

Best case - If a test fails a firm at least two years prior to bankruptcy, there will still be sufficient time to ensure the funding of alternative mechanisms; for this case the value of M is designated as M_B.

Worst case - If a test fails a firm at least three years prior to bankruptcy, there will still be sufficient time to ensure the funding of alternative mechanisms; for this case the value of M is designated as M_W.

Most probable case - All firms that are first eliminated by a test three years prior to bankruptcy will provide alternative financial assurance. One-half of the firms that are first eliminated two years prior to bankruptcy will provide alternative financial assurance. For this case the value of M is designated as M_P.

The implications of all three of these assumptions on the interpretation of possible classification results are presented in Table IV-1. Although the posibility of injunctive relief under Section 7003 of RCRA might render all three of these assumptions conservative estimates, the Agency has decided to use the "most probable case" definition of lead time requirements. (See, Hazardous Waste Section, Land and Natural Resources Division, United States Department of Justice, Annual Report (October 1980.)

(3) C represents the percentage of sampled bankrupt firms that fail a financial test with sufficient time remaining prior to bankruptcy to ensure that alternative financial mechanisms are available for facility closure, post-closure, and liability requirements. C is thus measured as:

$$C = 100 - M_P$$

(4) D represents the difference between the percentage of non-bankrupt firms passing a test and the percentage of bankrupt firms passing the test, and is called the "discriminating power" of a test. D is calculated according to the formula:

$$D = A_{NB} - M_W$$

The higher the D score, the better the test discriminates between bankrupt and non-bankrupt firms. A test receiving a D score of 100 would perfectly discriminate between bankrupt and non-bankrupt firms, passing all non-bankrupt firms and failing all bankrupt firms. A D score of zero would indicate that the same percentage of bankrupt firms pass a test as non-bankrupt firms, suggesting that the test does not discriminate between bankrupt and non-bankrupt firms. A negative D score indicates that more bankrupt firms pass a test than non-bankrupt firms.

223

TABLE IV-1

ESTIMATED PROBABILITY THAT A FIRM WILL NOT SET UP ALTERNATIVE FINANCIAL MECHANISMS FOR VARIOUS PATTERNS OF PASSING AND FAILING FINANCIAL TESTS

Test Result[1/]			Worst Case		Most Probable Case		Best Case	
1 Year Prior to Bankruptcy	2 Years Prior to Bankruptcy	3 Years Prior to Bankruptcy	Probability for One-Year Eligibility Requirement	Probability for Three-Year Eligibility Requirement	Probability for One-Year Eligibility Requirement	Probability for Three-Year Eligibility Requirement	Probability for One-Year Eligibility Requirement	Probability for Three-Year Eligibility Requirement
P	P	P	1.0	1.0	1.0	1.0	1.0	1.0
P	P	F	1.0	0	1.0	0	1.0	0
P	F	P	1.0	1.0	1.0	.5	1.0	0
P	F	F	1.0	0	1.0	0	1.0	0
F	P	P	1.0	1.0	1.0	1.0	1.0	1.0
F	P	F	1.0	0	1.0	0	1.0	0
F	F	P	1.0	1.0	.5	.5	0	0
F	F	F	0	0	0	0	0	0

[1/] P = Passes Test; F = Fails Test.

(5) E represents the number of firms per 10,000 which pass a given financial test and will enter bankruptcy without providing alternative financial assurances. E, like M, can be calculated for three different assumptions as to what constitutes sufficient lead time.

Best case - If a test fails a firm at least two years prior to bankruptcy, there will still be sufficient time to ensure the funding of alternative mechanisms; for this case the value of E is designated as E_B.

Worst case - If a test fails a firm at least three years prior to bankruptcy, there will still be sufficient time to ensure the funding of alternative mechanisms; for this case the value of E is designated as E_W.

Most probable case - All firms that are first eliminated by a test three years prior to bankruptcy will provide alternative financial assurance. One-half of the firms that are first eliminated two years prior to bankruptcy will provide alternative financial assurance. For this case, the value of E is designated as E_P.

E_P is used for most analytic purposes. A detailed formula for E_P, as noted in Section I, is:

$$E_P = \frac{F(M_P)}{((1-F) \times A_{NB}) + (F \times M_P)}$$

However, because of the very small values of F, a less complicated formula approximates this completely correct measure with an error of less than 1 percent for all tests examined. E_P is therefore calculated as:

$$E_P = \frac{F \times M_P}{A_{NB}}$$

B. Development of Ratio Tests

1. Evaluation of Single Ratio Tests

Each ratio listed in Section III.C.4 was tested against the primary bankrupt and non-bankrupt samples. Several pass-fail cutoff points were analyzed for each ratio since the midpoint values used in the historical literature often vary widely between studies. These single-ratio tests are summarized in Table IV-2.

In choosing ratios and cutoff points to employ in further tests, the Agency did not use the same sample as it used in the rest of this study. As noted in Section III, a larger primary sample which contained retail firms was employed in the earlier phases of this study. The evaluations of individual ratios and cutoff points shown in Table IV-2 were conducted using this larger sample and are reported in terms of that larger sample in this Section. This sample consisted of 60 bankrupt firms and 147 non bankrupt firms. M and C were evaluated using a three-year eligibility assumption, whereas A_{NB} was evaluated using a one-year eligibility assumption. However, results for the tests presented in Sections V and VIII are derived from the sample with retail firms removed.

As Table IV-2 illustrates, the cash flow/total liability ratio is the most significantly predictive single ratio, attaining the two highest D scores, the three highest C scores, and the four highest E ratings (i.e., the lowest number of firms per 10,000 that will fail without providing alternative financial assurance). The margins of

226

TABLE IV-2

PERFORMANCE OF SINGLE-RATIO TESTS 1/

Test Description	M_P 2/	M_W 2/	A_{NB} 3/	C 2/	D 4/	E_P 4/
CF/TL > .05	30.4	58.9	88.5	55.3	29.6	11.1
CF/TL > .1	12.5	32.1	83.8	77.7*	51.7*	5.9*
CF/TL > .15	5.4	17.9	69.9	88.3*	52.0*	3.7*
CF/TL > .2	5.4	8.9	52.0	92.8*	43.1*	3.0*
CF/TL > .3	5.4	3.6	24.5	95.5*	20.9	4.0*
TL/NW < 3.0	61.7	81.7	96.0	28.3	14.3	16.4
TL/NW < 2.0	35.0	61.7	90.7	51.7	29.0	11.7
TL/NW < 1.5	26.7	41.7	83.4	65.8	41.7*	9.0*
TL/NW < 1.2	16.7	31.7	67.5	75.8*	35.8	7.9*
TL/NW 1.0	11.7	25.0	60.9	81.6*	35.9	6.6*
NI/TA > 0	50.0	68.3	92.1	40.9	23.8	14.1
NI/TA > .02	21.7	43.3	83.4	67.5	40.1*	8.6*
NI/TA > .04	11.6	31.6	72.8	78.4*	41.2	6.5*
NWK/TA > 0	83.3	90.0	100.0	13.3	10.0	19.1
NWK/TA > .2	46.7	60.0	74.8	46.6	14.8	15.7
NWK/TA > .25	30.0	50.0	63.6	60.0	13.6	13.8
CURRAT > 1.2	66.7	76.7	98.7	28.3	22.0	16.0
CURRAT > 1.5	36.7	55.0	97.3	54.1	42.3*	10.4*
CURRAT > 2.0	18.3	31.6	74.9	75.0*	43.3*	7.3*
QRAT > 1.0	18.7	33.9	76.2	73.7*	42.3*	7.6*
QRAT > 1.2	13.6	25.5	53.1	80.4*	27.6	8.1*
NS/TA > 1.0	71.7	80.0	77.4	24.1	[-2.6]	21.6
NS/TA > 1.5	41.7	48.4	36.9	54.9	[-11.5]	26.9

1/ All values expressed in % terms except E_P which represents the number of firms (per 10,000 passing the test) that will fail without providing alternate financial assurance. All results are based on the original samples that included retail firms.

2/ Based on three-year eligibility requirement.

3/ Based on one-year eligibility requirement.

4/ Based on three-year eligibility requirement for M and one-year eligibility requirement for A_{NB}.

*Exceeds minimum performance cutoff point.

227

difference between the scores of the best cash flow ratios and those of other ratios are also substantial. Thirteen of the ratios tested reduced the normal failure rate for large (greater than $10 M in net worth) firms by more than 50 percent (from 22 per 10,000 to less than 11 per 10,000). Ten ratios eliminated more than 70 percent of bankrupt firms in sufficient time to establish alternative financial guarantee mechanisms; nine had a discriminatory power (D) of greater than 40 percent. If these three conditions are viewed to be the minimum acceptable values of test effectiveness, TL/NW, NI/TA, CURRAT, and QRAT all have cutoff scores that satisfy these criteria; only the net working capital to total assets and net sales to total assets ratios failed to provide significant results.

Those parametric values which satisfied one or more of the above minimum criteria (13 in all) were used to develop multi-ratio tests; the others were dropped from further consideration. There were two exceptions to this general classification rule: (1) the cash flow/total liability greater than .3 ratio was dropped, because the E ratings demonstrated that this test was already dominated by the .2 and .15 cash flow cutoff points, and its extremely high rate of non-bankrupt firm rejections made it a poor candidate for use in multi-ratio tests and (2) the total liabilities/net worth cutoff point of 2.0 was added to the list of ratios for detailed consideration, despite the fact that it failed to meet the minimum requirements, because preliminary investigations revealed that this ratio was one of the few that could be used effectively to classify electric utilities (see Section IV. B).

228

2. Evaluation of Multi-Ratio Tests

The 13 financial ratios selected from the initial evaluation process were linked in various combinations and then retested against the primary bankrupt and non-bankrupt samples. The ratios were combined in three ways: two-ratio tests (firm must pass both elements of the test to pass the test), three-ratio tests (firms must pass all elements to pass the test), and three-ratio contingent tests (firms must pass 2 of 3 elements to pass the test). Since CF/TL and NI/TA are alternative methods of measuring a firm's rate of return on its assets, these ratios were not included within the same test; the same procedure was followed with CURRAT and QRAT, the two liquidity measures being evaluated.

In all, 120 alternative tests were investigated in this phase. Section VIII presents the results of all tests both with one-year and three year liability requirements in Tables VIII-1 to VIII-4 and VIII-5 to VIII-8, respectively.

As illustrated in these Tables, two-ratio tests are more accurate than single-ratio tests in the C and E ratings. This pattern continues, at a somewhat lower rate of increase, for the more stringent three-ratio tests (passage of all elements required to pass). The three-ratio (pass 2 out of 3) tests evaluated barely out-performed the single-ratio cash flow tests on the C, D, and E measures. Although test formulations of the three-ratio type greatly increase the eligibility of firms in the non-bankrupt sample, they also increase misclassifications of bankrupt firms by a similar (and sometimes greater) amount.

229

The major problem with the multi-ratio tests evaluated in this phase is that the discriminating power (D score) of the best tests does not increase greatly. The greater levels of bankrupt firm identification and overall test effectiveness indicated in these results apparently are attained mainly by excluding a larger number of viable firms. Consequently, the Agency performed supplementary tests to establish whether there were other financial variables that could be added to these tests to improve their discriminating power, while retaining high levels of bankrupt firm detection.

3. Test of Supplementary Financial Ratios

Based on the results of the initial round of testing, a set of 32 non-bankrupt and 12 bankrupt firms was identified that were consistently misclassified by the tests evaluated in the first phase. The results achieved in testing this set of firms against a second set of financial ratios are summarized below.

The following ratios used in this auxiliary analysis were selected from the financial ratios tested in prior bankruptcy forecasting studies:

Retained earnings/total assets (RE/TA)

Earnings before interest and taxes/total assets (EBIT/TA)

Cash flow/net sales (CF/NS)

Balance sheet value of preferred and common stock/net worth (PC/NW)

Balance sheet value of preferred and common stock/current and long-term debt (PC/CL + LTL)

Net fixed assets/total assets (NFA/TA)

Cash/total assets (Cash/TA)

Cash/current liabilities (Cash/CL)

Net sales/total assets (NS/TA)

Net working capital/total assets (NWK/TA)

Values of each of the ratios were computed for the firms described above. The data were then analyzed to determine the values for each ratio that would provide the most accurate overall classification of the tested firms. The percentage of bankrupt and non-bankrupt firms that passed the resulting test were then compared to derive an estimate of the discriminating power (D') of each ratio. For this analysis, the value of D', defined as the difference between A_{NB} and M_P, was used. (This is similar to D, but substitutes M_P for M_W). These results are presented in Table IV-3.

In many cases, the ratio tested had higher values of M_P than of A_{NB}, resuitng in negative values for D'. A single ratio test with a negative discriminating power would not be likely to add to the overall effectiveness of financial tests combining several ratios. Three ratios -- RE/TA, NS/TA, and Cash/CL -- had some positive impact on firm categorization, with D' values of 15 to 24 percent. These results, however, were far exceeded by the classification results achieved by using the NFA/TA ratio. Three different cutoff points for NFA/TA were tested, with resulting D' ratings of 30 to 44 percent. More significantly, the ratio of NFA/TA greater than .3 correctly classified 9 of the 12 bankrupt firms as non-viable three years prior to bankruptcy.

231

TABLE IV-3

TESTS OF SUPPLEMENTARY FINANCIAL RATIOS[1]

Test Variables	M_P	A_{NB}	D'[2]
RE/TA > .2	41.7	62.5	20.8
RE/TA > .25	25.0	37.5	12.5
EBIT/TA > .12	41.7	43.8	2.1
NS/TA > 1.25	41.7	65.6	23.9
NS/TA > 1.4	41.7	50.0	8.3
CF/NS > .04	91.7	62.5	-29.2
CF/NS > .05	83.3	43.8	-39.5
PC/NW > .1	66.7	40.6	-26.1
PC/TL > .1	50.0	40.6	-9.4
NFA/TA > .15	50.0	93.5	43.5
NFA/TA > .25	33.3	61.3	28.0
NFA/TA > .3	25.0	54.8	29.8
Cash/TA > .04	50.0	65.6	15.6
Cash/CL > .15	50.0	46.9	-3.1
Cash/CL > .2	33.3	34.4	1.1
NWK/TA > .25	75.0	56.3	-18.7

[1] Tests run against a portion of the EPA primary bankrupt and non-bankrupt samples comprising 32 non-bankrupt and 12 bankrupt firms that were frequently misclassified by the initial set of candidate financial tests.

[2] D' = Difference between the percentage of viable firms passing a test and the percentage of non-viable firms passing the same test in year x-3.

The NFA/TA ratio represents the portion of a firm's assets tied to long-term tangible property, excluding the portion of these fixed assets that has already been depreciated. It represents the reserve of assets that a company can call on in a time of financial difficulties, either as a reliable source of earnings or a potential source (through sale) of needed capital. This ratio has not been extensively evaluated in previous bankruptcy forecasting studies; however, several studies have examined the ratio that represents to some extent its inverse -- current assets/total assets (CA/TA), the fraction of total assets in the form of cash, inventories, and short term receivables. Both Edmister (1972) and Deakin (1972) have found CA/TA to be a significant indicator of financial stability; and both studies have indicated that a high CA/TA is negatively correlated with continued firm solvency. A NFA/TA test also can be readily passed by almost all electric utilities, a category of hazardous waste disposers that encounters great problems in passing candidate tests using other more common financial ratios (see Section VI). For these reasons, the Agency decided to evaluate a number of tests incorporating NFA/TA as a variable against the entire primary sample. The results of these tests with one-year and three-year eligibility requirements are presented in Section VIII, Tables VIII-4 and VIII-8, respectively. As will be discussed in the next Section, most of the tests incorporating NFA/TA (Tests 121-151) dominate tests which do not incorporate this ratio.

V. TEST PERFORMANCE

A. Construction of the Performance Curves

The performance of a test is measured by two values: E_P, the number of firms per 10,000 which pass the test that later enter bankruptcy without providing alternative financial assurance; and A_{NB}, the percentage of non-bankrupt firms passing the test. Both of these values are used to determine the relative costs of alternative tests. In order to determine the best tests, the Agency ascertained, for particular values of E_P, the test which allows the highest value of A_{NB}. A test which, for any given value of E_P has the highest value of A_{NB}, is termed a dominant test.

Using the results for all tests of a given type (see Section VIII for complete test results), a graph was constructed for each of the eligibility requirements, depicting on one axis the number of bankrupt firms per 10,000 which pass the test, (E_P) and on the other axis the percentage of non-bankrupt firms which pass the test (A_{NB}).

Figure V-1 illustrates the method used to determine if a point C is on the performance curve. If a test is to be on the performance curve, there must be no other tests which dominate that test.

234

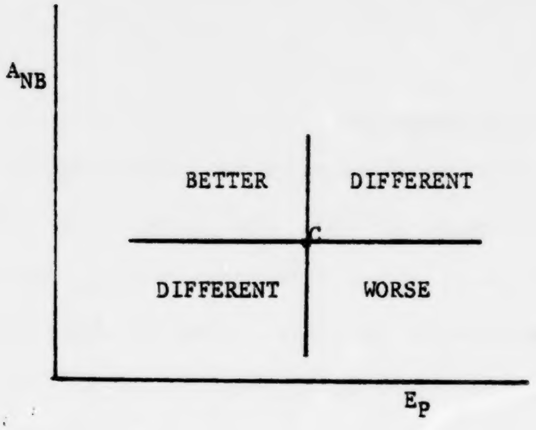


FIGURE V-1

TECHNIQUE FOR DETERMINING IF A POINT IS ON THE PERFORMANCE CURVE

For example, a particular test which passes 6 per 10,000 of bankrupt firms and passes 70 percent of non-bankrupt firms would have the coordinates of (6, 70%) in Figure V-1. To compare the performance of other tests to this test, as illustrated in the Figure, any tests represented by points in the northwest quadrant, using point C as the point of origin, dominate point C because both the value of E_P is lower (i.e., fewer bankrupt firms pass the test) and the value of A_{NB} is higher (i.e., a higher percentage of non-bankrupt firms pass the test.) A test with the coordinates (4, 80%) would fall in the northwest quadrant, and would indicate that 4 of 10,000 bankrupt firms and 80 percent of non-bankrupt firms pass the test. This makes it superior to the test represented by point C. Thus, if there were any tests with coordinates in the northwest quadrant, the test represented by point C would not be on

235

the performance curve. Similarly, any point in the southeast quadrant is absolutely inferior to point C.

Points in the other two quadrants cannot be classified as dominating point C, but can only be classified as different. For example, a point with coordinates (8, 80%) means that 80 percent of non-bankrupt firms pass the test, which is absolutely superior to point C; however, 8 out of 10,000 bankrupt firms also pass, which is inferior to point C. There is thus no way to classify any points in the northeast or southwest quadrants as dominant to point C. Points in those quadrants may or may not be on the performance curve; they would have to be evaluated in the same manner as point C.

Once the performance curve is constructed, it is sometimes useful to compare specific tests to the performance curve as a whole. If a test is plotted above the performance curve, then it dominates at least one test on the performance curve. If it is below the performance curve, then it is dominated by at least one test on the performance curve.

B. Performance Curves for the Primary Sample

Figure V-2 shows the performance curve for the set of 151 ratio tests with one-year eligibility requirements. Table V-1 lists the components of the tests and the values of E_P and A_{NB} for each test. Seventeen tests lie on the performance curve, thus reducing the set of tests that need to be further considered from 151 to 17. The performance curve includes tests ranging from a test with an E_P of 0 and an A_{NB} of 49 percent to one with an E_P of 10.1 and an A_{NB} of 96 percent.

FIGURE V-2

PERFORMANCE CURVE FOR TESTS WITH ONE-YEAR ELIGIBILITY REQUIREMENTS

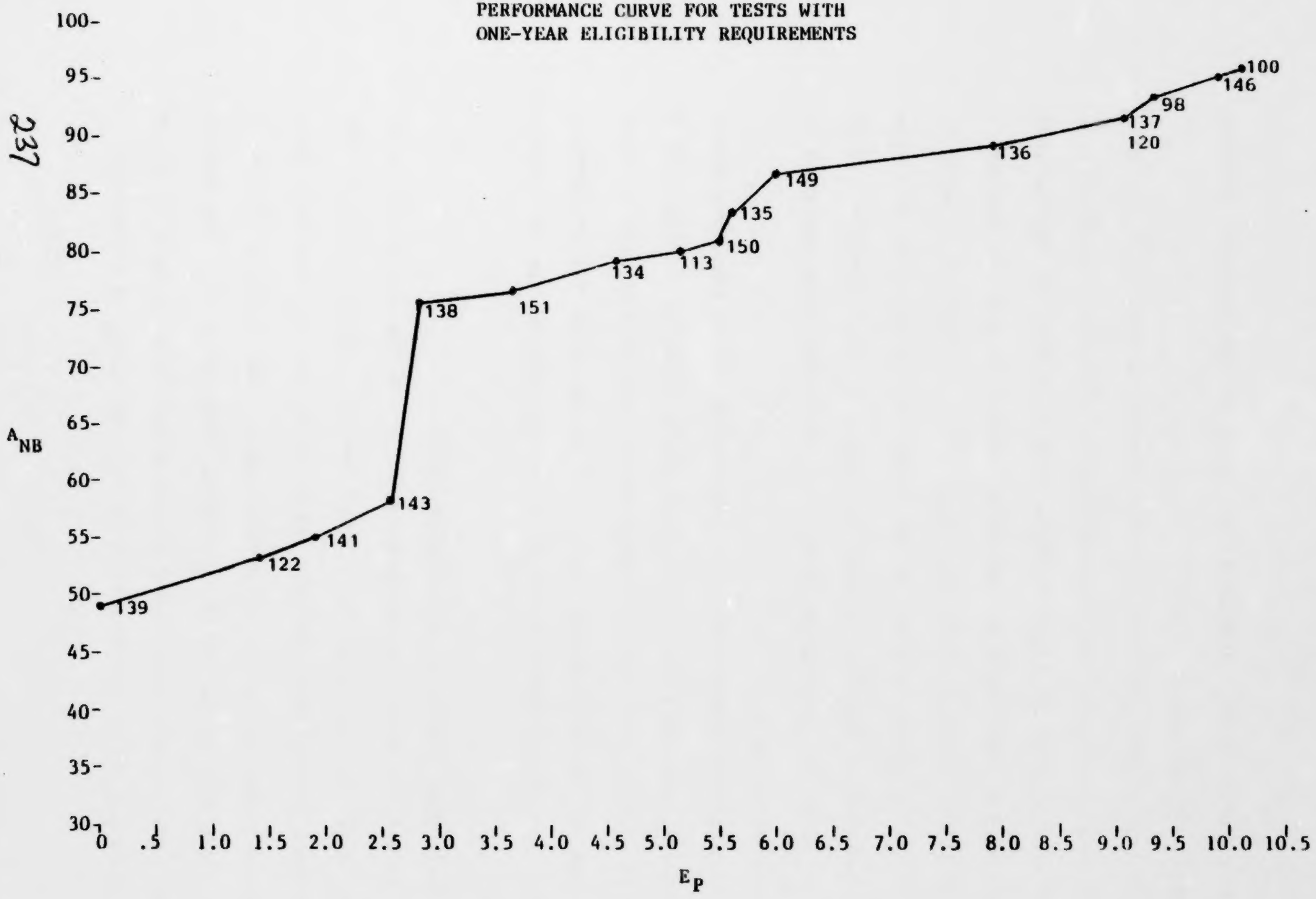


TABLE V-1

DOMINANT TESTS

(One-Year Eligibility Requirement)

Test Number	Test Variables	Number of Variables Required To Pass	E_P	A_{NB} (%)
139	NFA/TA > .3 CF/TL > .1 CURRAT >2.0	All	0	49
122	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	All	1.4	53
141	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	All	1.9	55
143	NFA/TA > .2 TL/NW < 1.2 QRAT > 1.0	All	2.6	58
138	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	All	2.8	76
151	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2 CURRAT > 2.0	3 of 4	3.7	77
134	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	2 of 3	4.6	79
113	CF/TL > .1 TL/NW < 1.0 QRAT > 1.0	2 of 3	5.2	80
150	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5 CURRAT > 2.0	3 of 4	5.5	81

TABLE V-1
(concluded)

Test Number	Test Variables	Number of Variables Required To Pass	E_P	A_{NB} (%)
135	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	2 of 3	5.6	83
149	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	3 of 4	6.0	87
136	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	2 of 3	7.9	89
120	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	2 of 3	9.1	92
137	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	2 of 3	9.1	92
98	CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	2 of 3	9.3	93
146	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	2 of 3	9.9	95
100	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	2 of 3	10.1	96

239

The tests on the performance curve had certain ratios in common. All tests on the performance curve included the cash flow to total liabilities ratio. Thirteen of the 17 tests on the performance curve included the net fixed assets to total assets ratio. Thirteen out of 17 tests included a total liabilities to net worth ratio.

Figure V-3 shows the performance curve (indicated by the heavy line) for the set of 151 ratio tests with a three-year eligibility requirement. The lighter line shows, for purposes of comparison, the performance curve for tests with a one-year eligibility requirement. Descriptions of these tests and their values for E_P and A_{NB} are given in Table V-2. Nine tests with a three-year eligibility requirement lie on this performance curve. The tests range from one with an E_P of 0 and an A_{NB} of 32 percent to one with an E_P of 7.3 and an A_{NB} of 86 percent. All of these tests include the cash flow to total liabilities ratio and the net fixed assets to total assets ratio.

Comparing these two curves shows that the general effect of a three-year eligibility requirement on any given test is to lower the values of both E_P and A_{NB}. The overall effect is relatively slight, with the following two exceptions: (1) Test 139 markedly improves with a one-year eligibility requirement; (2) only tests with a one-year eligibility requirement can achieve values of A_{NB} greater than 84 percent.

The choice between a one-year and three-year eligibility requirement cannot be based solely on performance, however, since the Agency must also consider the administrative burdens associated with different

FIGURE V-3

COMPARISON OF PERFORMANCE CURVE FOR TESTS WITH THREE-YEAR ELIGIBILITY REQUIREMENTS WITH PERFORMANCE CURVE FOR TESTS WITH ONE-YEAR ELIGIBILITY REQUIREMENTS

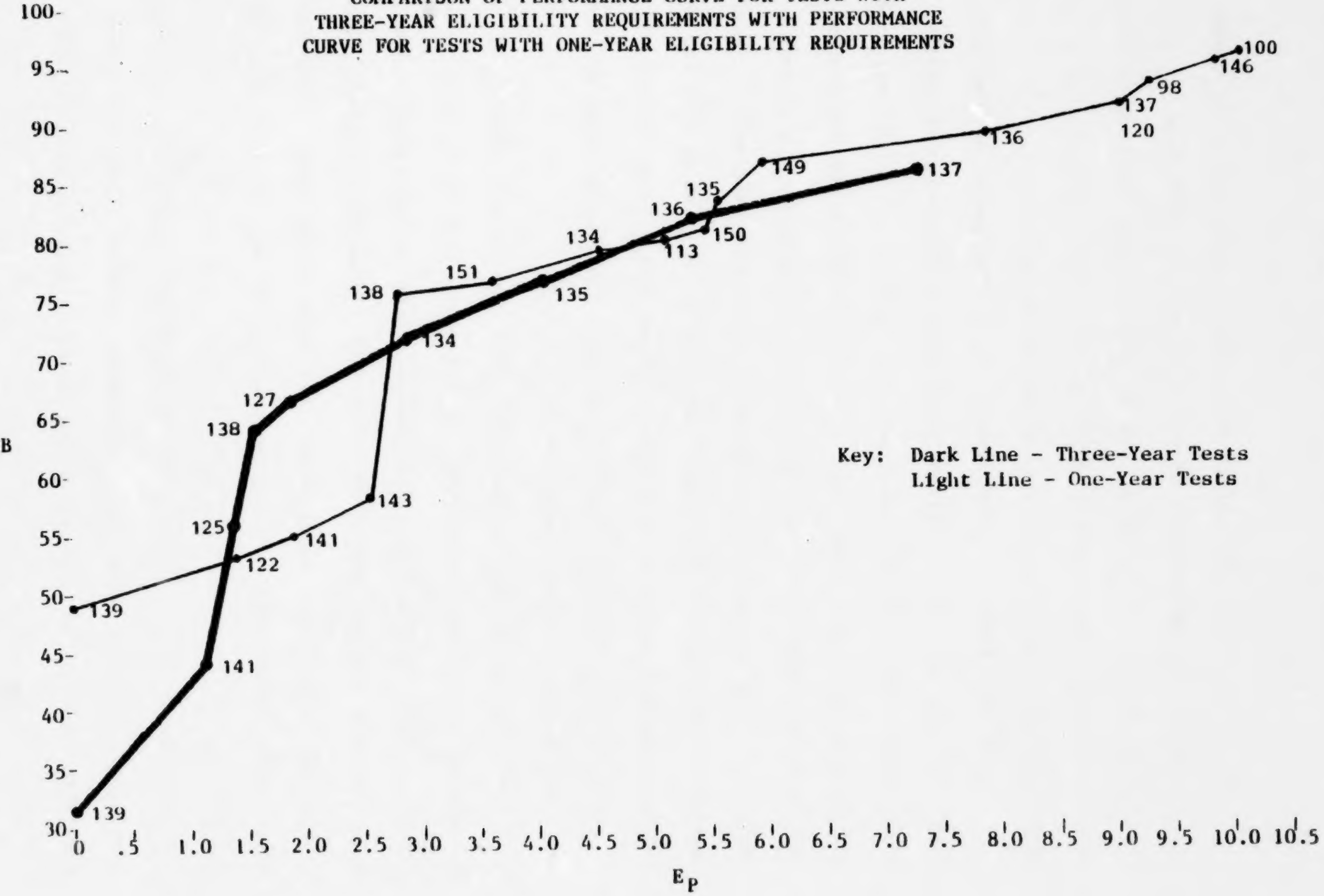


TABLE V-2

DOMINANT TESTS

(Three-Year Eligibility Requirement)

Test Number	Test Variables	Number of Variables Required To Pass	E_P	A_{NB} (%)
139	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0	All	0	32
141	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	All	1.2	44
125	NFA/TA > .25 CF/TL > .1 TL/NW < 1.5	All	1.4	56
138	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	All	1.6	64
127	NFA/TA > .2 CF/TL > .1 TL/NW < 2.0	All	1.9	67
134	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	2 of 3	2.9	72
135	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	2 of 3	4.1	77
136	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	2 of 3	5.4	82
137	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	2 of 3	7.3	86

tests. In order to assess the performance of one-year and three-year tests together, a merged performance curve, consisting of all the dominant tests without regard to eligibility requirements, was constructed. Such a curve is the envelope curve of the two performance curves shown in Figure V-3. Figure V-4 presents this envelope curve and Table V-3 presents a full description of the tests on this curve. This merged performance curve contains 16 tests, of which four have a three-year eligibility requirement, and 12 have a one-year eligibility requirement.

C. Performance with Respect to the Holdout Sample

As noted in Section III.B. the Agency used a holdout sample in this study to help ensure the statistical validity of the results. Figure V-5 compares the performance on the primary sample and on the holdout sample of those one-year eligibility tests that appeared on the primary sample performance curve; Figure V-6 provides this same comparison for three-year eligibility tests. Table V-4 compares the results of all tests with a one-year eligibility requirement and Table V-5 of all tests with a three-year eligibility requirement. Tables V-6 and V-7 provide complete holdout sample results for a larger set of tests.

For one-year eligibility tests, 11 of the 17 tests yield results for the holdout sample which lie above the performance curve for the primary sample. The remaining six tests are only slightly below the primary sample performance curve. This result strongly suggests that search bias has not led to tests which are incapable of validly discriminating between bankrupt and non-bankrupt firms when applied to samples

FIGURE V-4

PERFORMANCE CURVE OF BEST FINANCIAL TESTS WITH EITHER ONE-YEAR OR THREE-YEAR ELIGIBILITY REQUIREMENTS

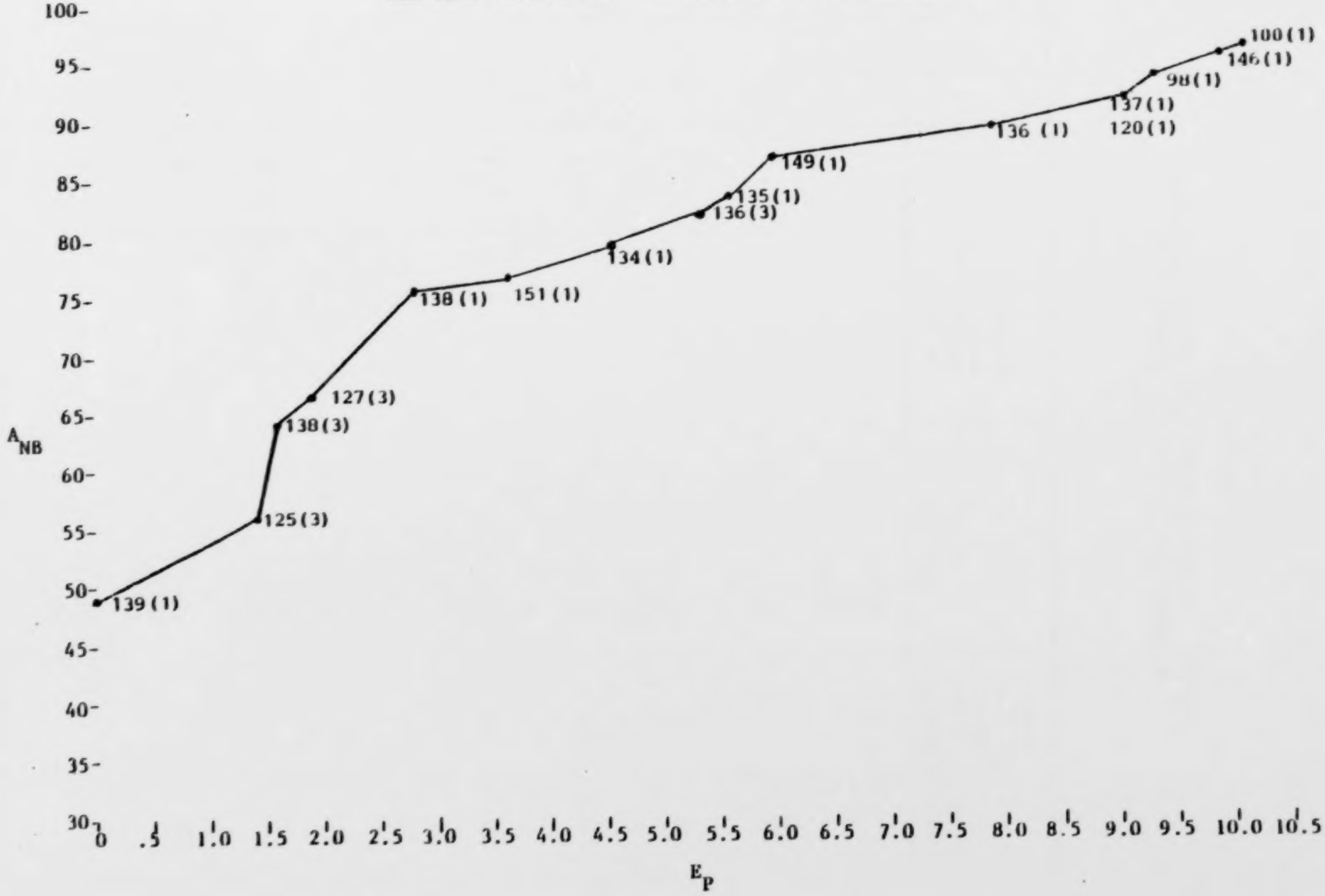


TABLE V-3

DOMINANT FINANCIAL TESTS WITH EITHER ONE-YEAR OR THREE-YEAR ELIGIBILITY REQUIREMENTS

Test Number	Number Of Years Required To Be Eligible	Test Variables	Number of Variables Required To Pass	E_P	A_{NB}
139	1	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0	All	0	49
125	3	NFA/TA > .25 CF/TL > .1 TL/NW < 1.5	All	1.4	56
138	3	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	All	1.6	64
127	3	NFA/TA > .2 CF/TL > .1 TL/NW < 2.0	All	1.9	67
138	1	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	All	2.8	76
151	1	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2 CURRAT > 2.0	3 of 4	3.7	77
134	1	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	2 of 3	4.6	79
136	3	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	2 of 3	5.4	82
135	1	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	2 of 3	5.6	83

TABLE V-3
(concluded)

Test Number	Number Of Years Required To Be Eligible	Test Variables	Number of Variables Required To Pass	E_P	A_{NB}
149	1	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	3 of 4	6.0	87
136	1	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	2 of 3	7.9	89
120	1	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	2 of 3	9.1	92
137	1	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	2 of 3	9.1	92
98	1	CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	2 of 3	9.3	93
146	1	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	2 of 3	9.9	95
100	1	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	2 of 3	10.1	96

FIGURE V-5

PERFORMANCE CURVE V. HOLDOUT SAMPLE PERFORMANCE
FOR TESTS WITH ONE-YEAR ELIGIBILITY REQUIREMENTS

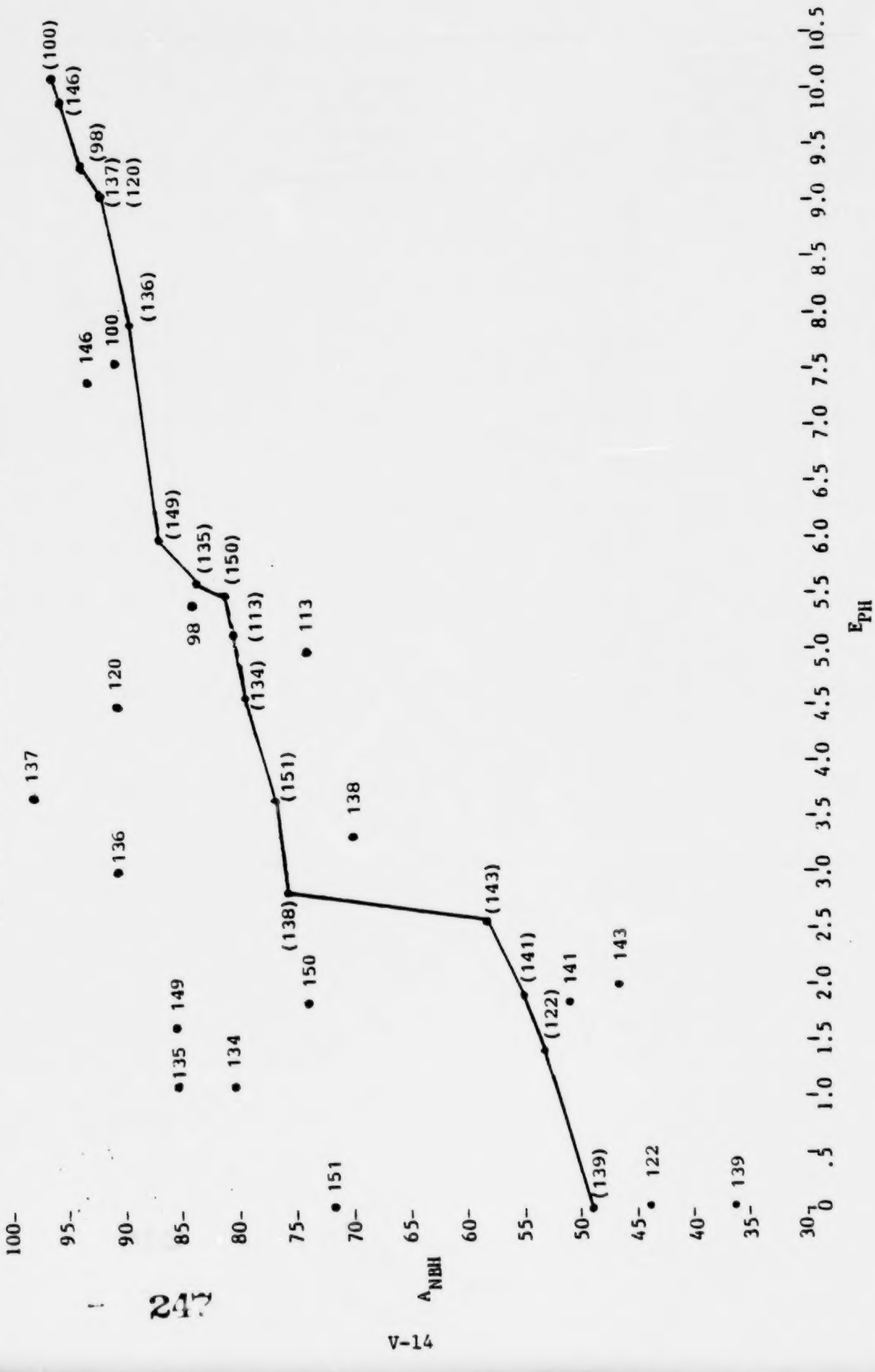


FIGURE V-6

PERFORMANCE CURVE V. HOLDOUT SAMPLE PERFORMANCE FOR TESTS WITH THREE-YEAR ELIGIBILITY REQUIREMENTS

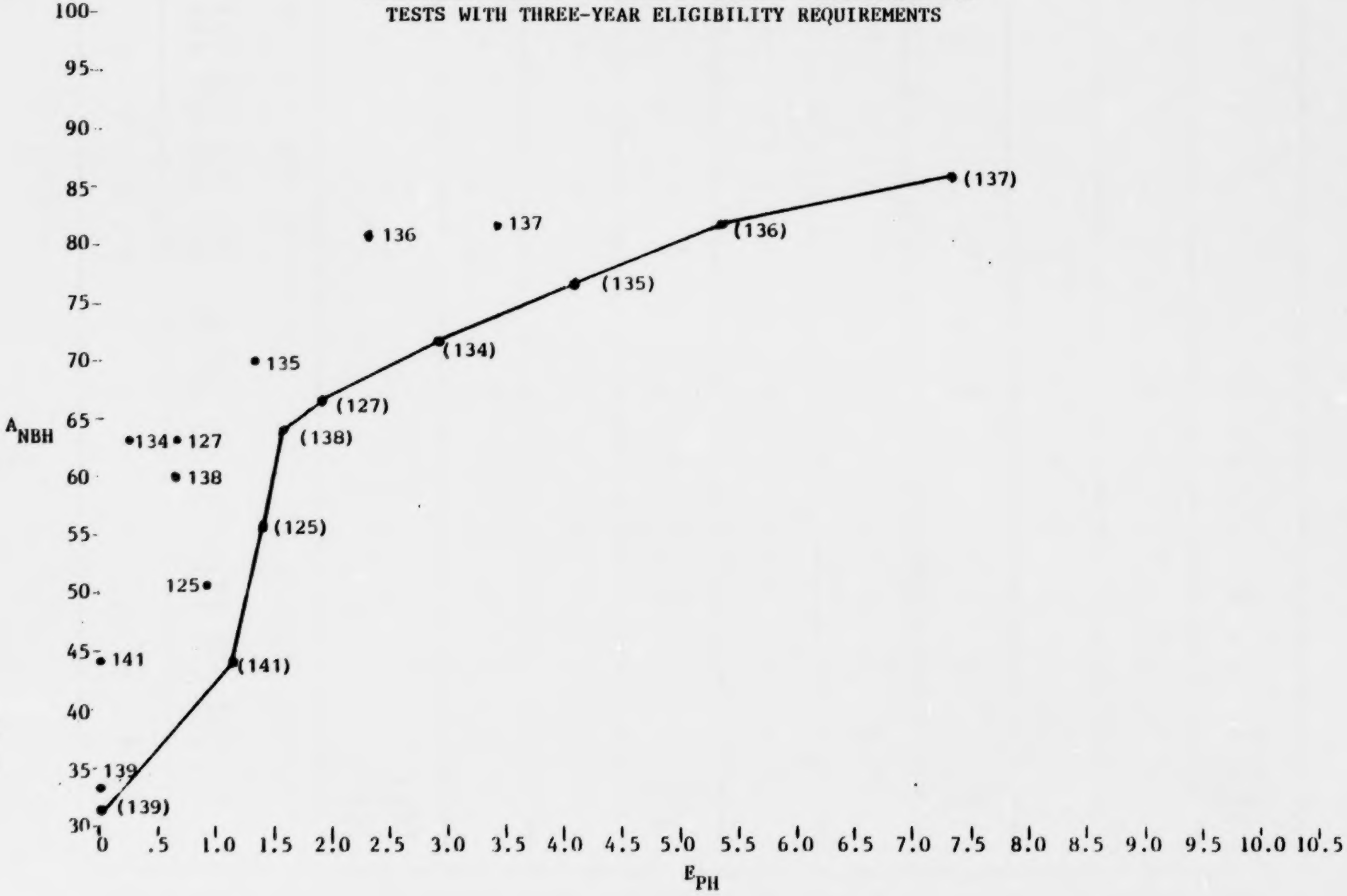


TABLE V-4

COMPARISON OF PRIMARY AND HOLDOUT SAMPLE PERFORMANCE FOR TESTS ON THE ONE-YEAR PERFORMANCE CURVE
(Subscript H Indicates Holdout Sample Result, No Subscript Indicates Primary Sample Result)

Test Number	Test Variables	Number of Variables Required To Pass	M_{PH}	M_P	Net Change* (M_P-M_{PH})	A_{NBH}	A_{NB}	Net Change* $(A_{NBH}-A_{NB})$	E_{PH}	E_P	Net Change* (E_P-E_{PH})
98	CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	2 of 3	20.8	39.2	+18.4	84	93	-9	5.4	9.3	+3.9
100	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	2 of 3	31.3	44.0	+12.7	91	96	-5	7.6	10.1	+2.5
113	CF/TL > .1 TL/NW < 1.0 QRAT > 1.0	2 of 3	14.6	19.0	+4.4	74	80	-6	4.3	5.2	+0.9
120	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	2 of 3	18.8	38.0	+19.2	91	92	-1	4.5	9.1	+4.6
122	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	All	0	3.5	+3.5	44	53	-9	0	1.4	+1.4
134	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	2 of 3	4.2	16.6	+12.4	81	79	+2	1.1	4.6	+3.5
135	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	2 of 3	4.2	21.4	+17.2	86	83	+3	1.1	5.6	+4.5
136	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	2 of 3	12.5	32.1	+19.6	91	89	+2	3.0	7.9	+4.9
137	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	2 of 3	16.7	38.0	+11.3	98	92	+6	3.7	9.1	+5.4
138	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	All	10.4	9.5	-0.9	70	76	-6	3.3	2.8	-0.5
139	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0	All	0	0	0	37	49	-12	0	0	0

TABLE V-4
(concluded)

Test Number	Test Variables	Number of Variables Required To Pass	M_{PH}	M_P	Net Change* (M_P-M_{PH})	A_{NBH}	A_{NB}	Net Change* $(A_{NBH}-A_{NB})$	E_{PH}	E_P	Net Change* (E_P-E_{PH})
141	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	All	4.2	4.7	+0.5	51	55	-4	1.8	1.9	+0.1
143	NFA/TA > .2 TL/NW < 1.2 QRAT > 1.0	All	4.2	7.1	+2.9	47	58	-11	2.0	2.6	+0.6
146	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	2 of 3	31.3	42.8	+11.5	93	95	-2	7.4	9.9	+2.5
149	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	3 of 4	6.3	23.8	+17.5	86	87	-1	1.6	6.0	+4.4
150	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5 CURRAT > 2.0	3 of 4	6.3	20.2	+13.9	74	81	-7	1.8	5.5	+3.7
151	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2 CURRAT > 2.0	3 of 4	0	13.0	+13.0	72	77	-5	0	3.7	+3.7

*In all cases, a positive value in the Net Change column represents an improvement in test performance in the holdout over the primary sample.

TABLE V-5

COMPARISON OF PRIMARY AND HOLDOUT SAMPLE PERFORMANCE FOR TESTS ON THE THREE-YEAR ELIGIBILITY PERFORMANCE CURVE

Test Number	Test Variables	Number of Variables Required To Pass	M_{PH}	M_P	Net Change* (M_P-M_{PH})	A_{NBH}	A_{NB}	Net Change* $(A_{NBH}-A_{NB})$	E_{PH}	E_P	Net Change* (E_P-E_{PH})
125	NFA/TA > .25 CF/TL > .1 TL/NW < 1.5	All	2.1	3.5	+1.4	51	56	-5	0.9	1.4	+0.5
127	NFA/TA > .2 CF/TL > .1 TL/NW < 2.0	All	2.1	5.9	+3.8	63	67	-4	0.7	1.9	+1.2
134	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	2 of 3	0	9.5	+9.5	63	72	-9	0	2.9	+2.9
135	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	2 of 3	4.2	14.3	+10.1	70	77	-7	1.3	4.1	+2.8
136	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	2 of 3	8.3	20.2	+11.9	81	82	-1	2.3	5.4	+3.1
137	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	2 of 3	12.5	28.5	+16.0	82	86	-4	3.4	7.3	+3.9
138	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	All	2.1	4.7	+2.6	60	64	-4	0.8	1.6	+0.8
139	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0	All	0	0	0	33	32	+1	0	0	0
141	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	All	0	2.3	+2.3	44	44	0	0	1.2	+1.2

*In all cases, a positive value in the Net Change column represents an improvement in test performance in the holdout over the primary sample.

TABLE V-6

PERFORMANCE OF BEST TESTS AGAINST HOLDOUT SAMPLE

(One-Year Eligibility Requirement)

Test Number	Test Variables	Number of Variables Required To Pass	E_B	E_P	E_W	A_{NB}
11	CF/TL > .1 TL/NW < 1.5	All	2.4	3.6	4.8	77
12	CF/TL > .1 TL/NW < 2.0	All	2.2	3.3	4.4	84
26	CF/TL > .1 CURRAT > 1.5	All	3.5	5.2	7.0	79
67	CF/TL > .1 TL/NW < 1.5 CURRAT > 1.5	All	2.5	3.8	5.1	72
68	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	All	2.4	3.6	4.8	77
98	CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	2 of 3	4.4	5.4	6.5	84
100	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	2 of 3	6.0	7.6	9.1	91
110	CF/TL > .1 TL/NW < 2.0 QRAT > 1.2	2 of 3	2.0	4.0	6.0	91
113	CF/TL > .1 TL/NW < 1.0 QRAT > 1.0	2 of 3	3.7	4.3	5.0	74
120	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	2 of 3	3.0	4.5	6.0	91

TABLE V-6
(continued)

Test Number	Test Variables	Number of Variables Required To Pass	E_B	E_P	E_W	A_{NB}
122	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	All	0	0	0	44
125	NFA/TA > .25 CF/TL > .1 TL/NW < 1.5	All	1.6	2.4	3.1	58
127	NFA/TA > .2 CF/TL > .1 TL/NW < 2.0	All	2.5	3.1	3.7	74
132	NFA/TA > .3 CF/TL > .15 TL/NW < 1.2	2 of 3	1.3	1.3	1.3	72
134	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	2 of 3	1.1	1.1	1.1	81
135	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	2 of 3	1.1	1.1	1.1	86
136	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	2 of 3	2.0	3.0	4.0	91
137	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	2 of 3	2.8	3.7	4.7	98
138	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	All	2.6	3.3	3.9	70

TABLE V-6
(concluded)

Test Number	Test Variables	Number of Variables Required To Pass	E_B	E_P	E_W	A_{NB}
139	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0	All	0	0	0	37
141	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	All	1.8	1.8	1.8	51
143	NFA/TA > .2 TL/NW < 1.2 QRAT > 1.0	All	2.0	2.0	2.0	47
146	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	2 of 3	4.9	7.4	10.8	93
149	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	3 of 4	1.1	1.6	2.1	86
150	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5 CURRAT > 2.0	3 of 4	1.2	1.8	2.5	74
151	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2 CURRAT > 2.0	3 of 4	0	0	0	72

TABLE V-7

PERFORMANCE OF BEST TESTS AGAINST HOLDOUT SAMPLE

(Three-Year Eligibility Requirement)

Test Number	Test Variables	Number of Variables Required To Pass	E_B	E_P	E_W	A_{NB}
11	CF/TL > .1 TL/NW < 1.5	All	1.5	2.9	4.4	63
12	CF/TL > .1 TL/NW < 2.0	All	1.4	2.7	4.1	67
26	CF/TL > .1 CURRAT > 1.5	All	0	2.1	4.2	65
67	CF/TL > .1 TL/NW < 1.5 CURRAT > 1.5	All	0	1.5	3.0	60
68	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	All	0	1.5	3.0	60
98	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	2 of 3	3.6	4.8	5.9	77
100	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	2 of 3	4.5	6.2	7.9	81
110	CF/TL > .1 TL/NW < 2.0 QRAT > 1.2	2 of 3	1.2	3.7	6.2	74
113	CF/TL > .1 TL/NW < 1.0 QRAT > 1.0	2 of 3	1.7	2.5	3.3	56
120	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	2 of 3	1.2	4.3	6.2	74
122	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	All	0	0	0	40

TABLE V-7 (Continued)

Test Number	Test Variables	Number of Variables Required To Pass	E_B	E_P	E_W	A_{NB}
125	NFA/TA > .25 CF/TL > .1 TL/NW < 1.5	All	0	90	1.8	51
127	NFA/TA > .2 CF/TL > .1 TL/NW <2.0	All	0	.73	1.5	63
132	NFA/TA > .3 CF/TL > .15 TL/NW <1.2	2 of 3	0	0	0	58
134	NFA/TA > .3 CF/TL > .1 TL/NW <1.0	2 of 3	0	0	0	63
135	NFA/TA > .3 CF/TL > .1 TL/NW <1.2	2 of 3	1.3	1.3	1.3	70
136	NFA/TA > .3 CF/TL > .1 TL/NW <1.5	2 of 3	1.1	2.3	3.4	81
137	NFA/TA > .3 CF/TL > .1 TL/NW <2.0	2 of 3	2.2	3.4	4.5	82
138	NFA/TA > .2 CF/TL > .1 CURRAT >1.5	All	0	.77	1.5	60
139	NFA/TA > .3 CF/TL > .1 CURRAT >2.0	All	0	0	0	33

TABLE V-7 (Concluded)

Test Number	Test Variables	Number of Variables Required To Pass	E_B	E_P	E_W	A_{NB}
141	NFA/TA > .2 CF/TL > .1 CURRAT >2.0	All	0	0	0	44
143	NFA/TA > .2 TL/NW <1.2 QRAT >1.0	All	2.3	2.3	2.3	40
146	NFA/TA > .2 CF/TL > .1 CURRAT >1.5	2 of 3	4.5	7.4	10.2	81
149	NFA/TA > .3 CF/TL > .1 TL/NW <2.0 CURRAT >2.0	3 of 4	0	.66	1.3	70
150	NFA/TA > .3 CF/TL > .1 TL/NW <1.5 CURRAT >2.0	3 of 4	0	.71	1.4	65
151	NFA/TA > .3 CF/TL > .1 TL/NW <1.2 CURRAT <2.0	3 of 4	0	0	0	63

other than the sample used in the test selection. The results for the three-year eligibility tests further confirm the validity of the tests selected. All nine three-year eligibility tests for the holdout sample lie above the primary sample performance curve. For the tests on the merged performance curve, only three of the 16 tests on the performance curve lie below the merged primary sample performance curve.

Although the holdout sample results attest to the validity of the selection procedure for the tests on the primary sample performance curve, they are less encouraging with respect to the accuracy of the estimates of E_P and A_{NB}. When one-year eligibility tests on the primary sample performance curve are tested against the holdout sample, A_{NB} falls by an average of four percentage points while E_P falls by an average of 2.6. Similar results are obtained for tests with a three-year eligibility requirement. While small changes in the values of A_{NB} are not surprising given the sample size, the changes in E_P are unexpectedly high, given that the primary and holdout sample were randomly assigned from the same original sample of firms. Apparently, the resulting holdout sample contained firms with much weaker financial performance two to three years prior to bankruptcy than the primary sample.

If the results of the primary sample are used, Test 100 (one-year) has the highest value of A_{NB} of any of the ratio tests examined. If the results of the holdout sample are used, Test 137 (one-year) is superior to Test 100 (one-year), with both a higher A_{NB} and a lower E_P.

As a further check on the relative performance of these tests, E_P and A_{NB} were calculated using a weighted average of the performance for the primary and holdout samples. These results are shown in Table V-8. Using these weighted average results, all three tests would lie on a performance curve, with none absolutely dominating the others.

D. Comparison to the Results of Other Tests

1. Other tests examined

This Section reports the performance of the other types of tests which were examined in this study in addition to the ratio tests.

One of the other tests evaluated was the financial test proposed by the Agency on May 19, 1980. That test consisted of the following elements:

Total liabilities to net worth < 3

Net working capital > 2 X closure plus post-closure costs

Net worth > $10 million

This test had a one-year eligibility requirement. The effect of the net worth requirement and the total liabilities to net worth ratio in eliminating bankrupt firms while admitting viable firms was evaluated using the same methodology used for deriving the performance of the ratio tests. The effect of the multiple requirement on the performance of the test is more difficult to evaluate. A requirement that net working capital be a multiple of total financial responsibility obligations means that net working capital must be positive. As a result, the May 19 test was evaluated as a test which required a ratio of total liabilities to net worth of less than three and a current ratio of greater

TABLE V-8

PERFORMANCE OF SELECTED LESS STRINGENT TESTS USING WEIGHTED AVERAGES OF HOLDOUT AND PRIMARY SAMPLE TO DETERMINE E_P AND A_{NB}

Test Number	Number of Years Required To Be Eligible	Test Variables	Number of Variables Required To Pass	E_P	A_{NB}
137	1	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	2 of 3	7.1	93
146	1	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	2 of 3	9.0	94
100	1	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	2 of 3	9.2	95

than one (i.e., the ratio of current assets to current liabilities must be greater than one for there to be positive net working capital).

The Agency also evaluated tests which were composed only of multiple elements. In this report, the term "Ability to Pay Test" refers to those tests that required that net worth and net working capital each exceed six times the total financial responsibility obligation to be covered through a financial test. The performance of those tests was evaluated in the same manner as the performance of the May 19, 1980 tests. That is, the net worth multiple was ignored as implicitly accounted for by the $10 million in net worth requirement, and the current ratio was required to be greater than one. The Agency evaluated the Ability to Pay test using both one-year and three-year eligibility requirements.

The performances of the May 19, 1980 and Ability to Pay tests are shown in Table V-9. Neither the proposed May 19, 1980 test nor the two Ability to Pay tests are dominated by other tests, and therefore all are added to the performance curve. These tests pass almost all viable firms, but also have very high values of E_P.

The presence in a test of multiple elements of the type included in the Ability to Pay Tests does not influence the E_P or A_{NB} results. All ratio tests of any importance fail firms that would have failed a test including a requirement that the current ratio be greater than 1. As a result, the addition of such a requirement to a ratio test does not alter either the A_{NB} or E_P of the test.

TABLE V-9

PERFORMANCE OF SELECTED TESTS WITH RESPECT TO THE PRIMARY SAMPLES

Test Description	Parameters Tested	Eligibility Requirement	A_{NB}	E_P
May 19, 1980 Test	TL/NW $<$ 1 CURRAT $>$ 1	One-Year	97	15.1
Ability to Pay Test	CURRAT $>$ 1	One-Year	100	20.2
Ability to Pay Test	CURRAT $>$ 1	Three-Year	99	18.4

2. Comparison to Results Obtained by Other Investigators

As noted in Section II, a number of studies have been published on methods for forecasting bankruptcies. The most commonly used method in these studies has been multi-discriminant analysis. The disadvantage to this approach is that tests based upon multi-discriminant analysis would require much more extensive reporting forms and would be more difficult to check. Nevertheless, the Agency concluded that if multi-discriminant analysis would lead to results clearly superior to those of the tests adopted in this study, it should consider adopting one of the tests from the published literature rather than one of the tests it had developed. The Agency therefore compared its results to the results reported in the literature.

Four of the studies which utilized multi-discriminant analysis were further examined: Altman (1968), Altman et al. (1977), Deakin (1972) and Deakin (1976). All of these studies examined the same basic problem as that examined here: forecasting bankruptcies for relatively large firms engaged in manufacturing and, in some cases, retail trade.

The first step in the comparison was to examine the results of these studies as reported, and to use the baseline failure rate employed in this study to derive a measure of E_p comparable to that used in reporting the results of this study. Multi-discriminant analysis is particularly prone to search bias, with the result that performance with respect to the holdout sample is almost always weaker than that with the primary sample. Whenever possible, the performance reported for these studies is that obtained against a holdout sample. (This was not possible for Altman et al. (1977) because no holdout sample was employed.)

The results for these studies are shown in Table V-10. The A_{NB} and E_P for each study are plotted on a graph showing the performance curve and holdout results for one-year eligibility tests in Figure V-7. As can be seen from the Figure, the reported result for Deakin (1976) is dominated by both the primary sample performance curve and by many of the results from the holdout sample. The Deakin (1972) result is, however, extremely strong and would be a dominant test even on a performance curve consisting only of results from the holdout sample.

The problem with these comparisons is that each study reported used a different sample of bankrupt and non-bankrupt firms, with the result that comparisons of performance may simply reflect different sample characteristics rather than the actual relative strength of the tests. Table V-11 compares the means of the samples used in various studies with the mean of the samples for the Agency primary and holdout samples. As shown in the Table, the means of the key financial variables for the Agency bankrupt firm sample are higher than those of firms used in other studies, which indicates that the firms used by the Agency had greater average financial strength. This difference could be expected to result in higher E_P scores for the other tests if the Agency bankrupt samples had been used in evaluating those other tests. The non-bankrupt sample of firms shows more mixed results. In some cases the means of the EPA samples show greater financial strength; in other cases, other studies show greater financial strength. Thus no strong conclusion is possible about how A_{NB} for other studies would change if applied to the Agency samples.

TABLE V-10

ESTIMATED PERFORMANCE OF TESTS DEVELOPED BY PRIOR BANKRUPTCY FORECASTING STUDIES

Study Name	Type of Test	M_B	M_W	A_{NB}	E_P
Altman (1968)[1]	5-Variable MDA	17.0	29.4	87.1	5.8
Altman (1977)[2]	7-Variable MDA	15.1	25.5	89.1	5.0
Deakin (1972)[3]	14-Variable MDA	8.0	18.0	94.0	3.0
Deakin (1976)[4]	5-Variable MDA	NA	17.0	75.0	5.0

[1] Performance based upon results reported in Altman (1977). No Holdout Sample was used in Altman (1968), but this test was evaluated against the new sample developed in Altman (1977). Note that Altman (1977) Bankrupt Sample contains 5 firms which did not fail.

[2] Primary Sample Performance from Altman (1977). No Holdout Sample was used.

[3] Holdout Sample results are reported in Deakin (1972).

[4] M_W based on results reported for M for all firms passing the test and entering bankruptcy from 1-3 years following passing the test.

FIGURE V-7

RESULTS OF OTHER STUDIES PLOTTED WITH EPA ONE-YEAR
PERFORMANCE CURVE AND HOLDOUT SAMPLE RESULTS

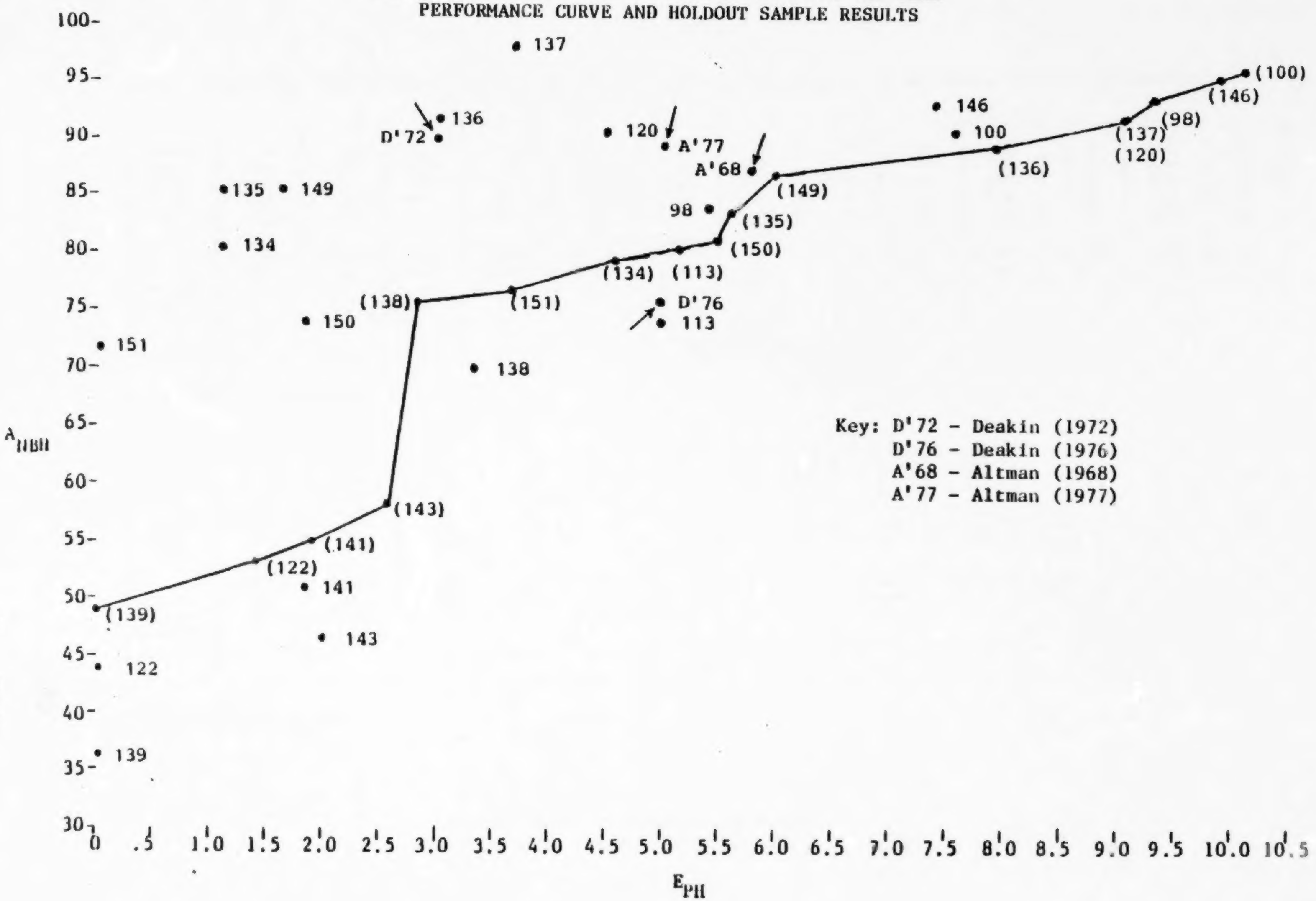


TABLE V-11

COMPARISON OF SAMPLE MEANS FOR EPA AND OTHER BANKRUPTCY FORECASTING STUDIES

A. Bankrupt Firms Samples:

Financial Parameter	Data Year											
	x-1				x-2				x-3			
	EPA Primary	EPA Holdout	Deakin (1972)	Altman (1968)	EPA Primary	EPA Holdout	Deakin (1972)	Altman (1968)	EPA Primary	EPA Holdout	Deakin (1972)	Altman (1968)
CF/TL	-.046	-.117	-.088	NA	.017	-.007	-.052	NA	.049	.008	-.001	NA
TL/NW	7.78	3.22	-51.00	26.78	3.67	3.67	10.66	3.35	1.84	3.99	8.52	1.58
CURRAT	1.51	1.35	.70	1.33	1.58	1.60	.89	1.31	1.97	1.72	1.44	1.62
QRAT	.77	.67	.35	NA	.87	.77	.48	NA	1.07	.90	.53	NA
NWK/TA	.13	.09	-.21	-.06	.18	.22	-.07	.02	.25	.23	.18	.18

B. Non-Bankrupt Firm Samples:

Financial Parameter	Data Year												
	x-1					x-2				x-3			
	EPA Primary	EPA Holdout	Deakin (1972)	Altman (1968)	Altman (1977)	EPA Primary	EPA Holdout	Deakin (1972)	EPA Utilities	EPA Primary	EPA Holdout	Deakin (1972)	EPA Utilities
CF/TL	.261	.239	.132	NA	.314	.278	.172	.150	.114	.271	.232	.115	.113
TL/NW	1.08	.997	1.15	NA	NA	1.18	1.07	.89	1.41	1.20	1.17	.91	1.41
CURRAT	2.75	2.61	2.33	NA	2.60	2.29	2.26	2.37	1.26	2.42	2.50	2.51	1.11
QRAT	1.38	1.40	1.13	NA	NA	1.22	1.26	1.18	.91	1.37	1.45	1.24	.74
NWK/TA	.30	.32	.33	.41	NA	.29	.30	.33	.02	.28	.32	.35	.01

SOURCE: Moody's Industrial Manual and company annual Form 10-K reports for EPA samples; original articles cited for other samples.

In order to provide better methods of comparing tests, Deakin (1972) tests were evaluated using the Agency holdout sample using E_W rather than E_P. The Agency used E_W because it required gathering only one year rather than two years of additional data. The result of this evaluation is shown in Figure V-8 and the results of the Deakin test are summarized in tabular form in Table V-12. When both the Agency's and Deakin's tests are compared against the same sample of firms, the performance is comparable. Seven of the Agency's tests fall below the performance curve for Deakin's test and seven are above it. Two of the one-year eligibility tests are not comparable. (If the line connecting the last two points representing Deakin's tests were extended, both of these noncomparable tests would be above this hypothetical performance curve.)

FIGURE V-8

COMPARISON OF EPA AND DEAKIN (1972) TESTS USING EPA HOLDOUT SAMPLE

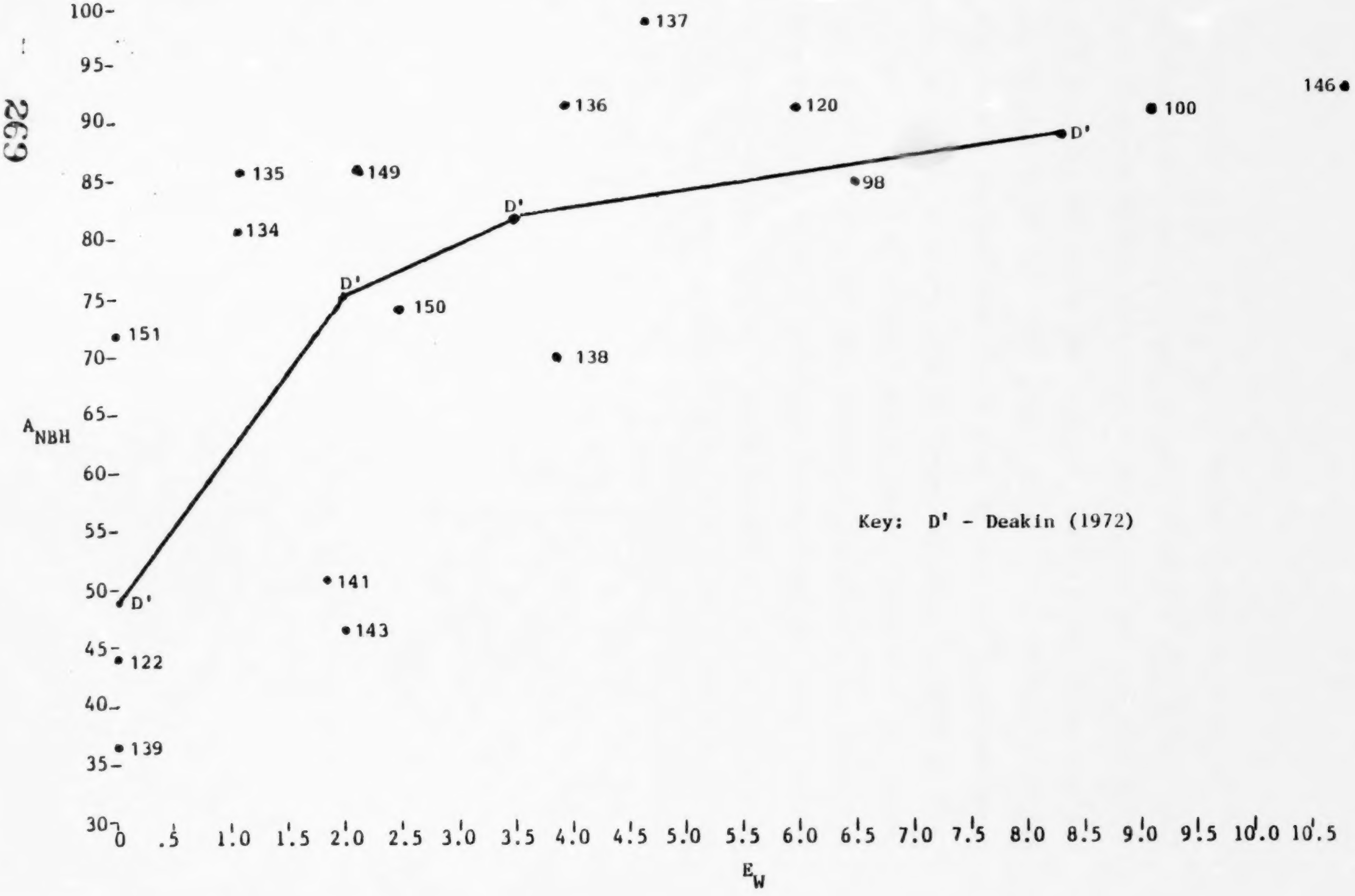


TABLE V-12

PERFORMANCE OF DEAKIN 14-VARIABLE TEST VERSUS EPA HOLDOUT SAMPLES*

Test Cutoff Score	E_{PH} (x-3)	A_{NBH}	D	E_W
20.0	0	49	49	0
25.0	9.4	74	66	2.4
27.0	12.9	81	68	3.5
30.0	31.2	88	55	8.3

*C and E_P scores cannot be computed because only one year of data, x-3, was analyzed against the Deakin test.

VI. THE NEED FOR ALTERNATIVE TESTS FOR SPECIFIC INDUSTRIES

A number of commenters argued that no single financial test could be selected as an appropriate indicator of firm viability, because financial ratios varied greatly among industries. Many of these same commenters proposed that separate financial tests should be formulated for each industry category. The Agency was generally opposed to such a concept, because such a structure would greatly increase the administrative complexity of the financial responsibility regulations. Initially, it would be a difficult task to determine the number and type of categories that would be appropriate for this purpose. For many industries, data on bankrupt firms would be so limited that the statistical validity of a test derived from such data would be very questionable. Furthermore, even if a framework and set of tests could be established, many large firms with diversified facilities would not fit easily into any classification scheme. For example, if a parent firm primarily involved in chemicals manufacturing attempted to use the financial test provision to guarantee the waste disposal operations of its subsidiary, a pulp mill, a decision rule would have to be developed on whether the firm should be classified under the chemicals or paper category. The Agency believes that the addition of such complexities could only be justified if there is compelling evidence that the financial test alternatives evaluated in this analysis all discriminated against specific industries.

This Section examines the need for industry specific tests for three categories of industry: manufacturing firms by two digit SIC classification; utilities; and hazardous waste management firms.

A. Manufacturing Industries

To test the hypothesis that specific manufacturing industries may be unable to pass a general financial test, the Agency collected financial data for all the firms listed in the Expanded Coverage section of the 1980 Moody's Industrial Manual (Volume 1). Using the Dun and Bradstreet Million Dollar Directory, the Agency identified the 2-digit SIC classifications corresponding to each firm's major manufacturing activities. Table VI-1 shows the number of firms examined by 2-digit SIC classification activities. The Agency then tested this sample against the four financial ratios which consistently provided the best classification performance in the initial evaluation of test alternatives: cash flow/total liabilities, total liabilities/net worth, net fixed assets/total assets, and current assets/current liabilities.

The results of this evaluation, as shown in Tables VI-2 through VI-5, do not in any way support the argument for industry-specific tests. Although there are some isolated differences between industries in cases where stringent ratio cutoff points are assumed, each of the four ratios has at least one commonly used cutoff value (NFA/TA > .2, CF/TL > .1, TL/NW < 2.0, CURRAT > 1.5) which at least 75 percent of the firms in each 2-digit SIC can pass. The discrimination among industry groups resulting from the use of a single test therefore appears slight and well within the boundaries of difference illustrated by other financial indicators (e.g., bond ratings). Consequently, there is no justification for requiring industry specific tests for manufacturing industries.

TABLE VI-1

NUMBER OF FIRMS BY SIC CLASSIFICATION USED IN TABLES VI-2 THROUGH VI-6

SIC	Description of Industry	Number of Firms
20	Food and kindred products	33
22	Textile mill products	8
24	Lumber and wood products, except furniture	15
26	Paper and allied products	17
28	Chemicals and allied products	51
29	Petroleum refining and related industries	13
30	Rubber and miscellaneous plastics products	29
32	Stone, clay, glass, and concrete products	19
33	Primary metal industries	26
34	Fabricated metal products, except machinery and transportation products	44
35	Machinery, except electrical	65
36	Electrical and electronic machinery, equipment and supplies	38
37	Transportation equipment	33
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	20
39	Miscellaneous manufacturing industries	14

TABLE VI-2

PERCENTAGES OF FIRMS IN MANUFACTURING INDUSTRIES PASSING OR FAILING GIVEN CASH FLOW/TOTAL LIABILITY (CF/TL) REQUIREMENTS
(Based on Sample Described in Text)

SIC	Description of Industry	CF/TL			
		< .10	>.10	>.15	>.20
20	Food and kindred products	9.1	90.9	72.7	48.5
22	Textile mill products	18.7	81.3	62.5	50.0
24	Lumber and wood products, except furniture	13.3	86.7	73.3	60.0
26	Paper and allied products	-	100.0	88.2	64.7
28	Chemicals and allied products	9.8	90.2	72.5	47.1
29	Petroleum refining and related industries	7.7	92.3	76.9	53.8
30	Rubber and miscellaneous plastics products	3.4	96.6	75.9	55.2
32	Stone, clay, glass, and concrete products	10.5	89.5	84.2	68.4
33	Primary metal industries	3.8	96.2	61.5	42.3
34	Fabricated metal products, except machinery and transportation products	6.8	93.2	68.2	40.9
35	Machinery, except electrical	7.7	92.3	72.3	50.8
36	Electrical and electronic machinery, equipment, and supplies	10.5	89.5	81.6	57.9
37	Transportation equipment	9.1	90.9	66.7	24.2
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	-	100.0	75.0	55.0
39	Miscellaneous manufacturing industries	7.1	92.9	64.3	57.1

TABLE VI-3

PERCENTAGE OF FIRMS IN MANUFACTURING INDUSTRIES PASSING OR FAILING GIVEN NET FIXED ASSETS/TOTAL ASSETS (NFA/TA) REQUIREMENTS

(Based on Sample Described in Text)

SIC	Description of Industry	NFA/TA			
		<.20	>.20	>.25	>.30
20	Food and kindred products	9.1	90.9	75.8	66.7
22	Textile mill products	-	100.0	93.8	87.5
24	Lumber and wood products, except furniture	13.3	86.7	73.3	66.7
26	Paper and allied products	-	100.0	100.0	94.1
28	Chemicals and allied products	7.8	92.2	80.4	72.5
29	Petroleum refining and related industries	-	100.0	92.3	92.3
30	Rubber and miscellaneous plastics products	10.3	89.7	89.7	86.2
32	Stone, clay, glass, and concrete products	10.5	89.5	78.9	78.9
33	Primary metal industries	3.8	96.2	84.6	76.9
34	Fabricated metal products, except machinery and transportation products	13.6	86.4	72.7	63.6
35	Machinery, except electrical	18.5	81.5	70.8	50.8
36	Electrical and electronic machinery, equipment, and supplies	21.1	78.9	71.1	47.4
37	Transportation equipment	12.1	87.9	75.8	51.5
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	20.0	80.0	65.0	55.0
39	Miscellaneous manufacturing industries	28.6	71.4	50.0	42.9

TABLE VI-4

PERCENTAGE OF FIRMS IN MANUFACTURING INDUSTRIES PASSING OR FAILING GIVEN TOTAL LIABILITIES/NET WORTH (TL/NW) REQUIREMENTS
(Based on Sample Described in Text)

SIC	Description of Industry	TL/NW				
		>2.0	< 2.0	< 1.5	< 1.2	< 1.0
20	Food and kindred products	9.1	90.9	78.8	69.7	42.4
22	Textile mill products	-	100.0	93.8	75.0	56.3
24	Lumber and wood products, except furniture	20.0	80.0	73.3	73.3	46.7
26	Paper and allied products	5.9	94.1	88.2	76.5	52.9
28	Chemicals and allied products	3.9	96.1	80.4	47.1	31.4
29	Petroleum refining and related industries	7.7	92.3	61.5	46.2	15.4
30	Rubber and miscellaneous plastics products	3.4	96.6	86.2	65.5	48.3
32	Stone, clay, glass, and concrete products	10.5	89.5	84.2	63.2	57.9
33	Primary metal industries	3.8	96.2	73.1	57.7	38.5
34	Fabricated metal products, except machinery and transportation products	6.8	93.2	75.0	52.3	36.4
35	Machinery, except electrical	6.2	93.8	83.1	58.5	46.2
36	Electrical and electronic machinery, equipment, and supplies	5.3	94.7	81.6	63.2	44.7
37	Transportation equipment	6.1	93.9	69.7	39.4	24.2
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	-	100.0	85.0	80.0	40.0
39	Miscellaneous manufacturing industries	14.3	85.7	78.6	64.3	57.1

TABLE VI-5

PERCENTAGE OF FIRMS IN MANUFACTURING INDUSTRIES PASSING OR FAILING GIVEN CURRENT RATIO (CURRAT) REQUIREMENTS

(Based on Sample Described in Text)

SIC	Description of Industry	CURRAT		
		< 1.5	>1.5	>2.0
20	Food and kindred products	6.1	93.9	48.5
22	Textile mill products	6.2	93.8	68.8
24	Lumber and wood products, except furniture	6.7	93.3	53.3
26	Paper and allied products	5.9	94.1	70.6
28	Chemicals and allied products	9.8	90.2	56.9
29	Petroleum refining and related industries	23.1	76.9	15.4
30	Rubber and miscellaneous plastics products	3.4	96.6	69.0
32	Stone, clay, glass, and concrete products	5.3	94.7	68.4
33	Primary metal industries	3.8	96.2	53.8
34	Fabricated metal products, except machinery and transportation products	6.8	93.2	68.2
35	Machinery, except electrical	9.2	90.8	58.5
36	Electrical and electronic machinery, equipment, and supplies	13.2	86.8	50.0
37	Transportation equipment	15.2	84.8	54.5
38	Measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks	-	100.0	70.0
39	Miscellaneous manufacturing industries	-	100.0	64.3

B. Electric Utilities

In their comments on the proposed financial test of May 19, 1980, firms in the electric utility industry asserted that utilities could not be analyzed using "normal" financial logic, and should be judged under alternative criteria. Utilities objected to the use of net working capital as a required component of a financial test, since many firms in each category operate regularly from a negative net working capital position. Both the data submitted by the commenters and an independent check by the Agency verified that utilities do operate with negative net working capital. As a result, any test which requires that net working capital be some multiple of financial responsibility obligations will fail most utilities.

The Agency also examined the question of the extent to which specific ratio requirements might consistently fail viable utilities. To examine this issue, a sample of 26 electric utilities were drawn from the 1978 and 1979 Moody's Public Utilities Manual (see Table VI-6). Table VI-7 illustrates the performance of this sample against the key single-ratio tests identified in Section IV. As can be seen, a number of these ratios are totally unsuited for analyzing utility viability. The following financial ratios and pass-fail cutoff points were identified as potentially acceptable tests:

CF/TS > .1

TL/NW < 2.0, < 1.5

NI/TA > .02, > .04

NFA/TA > .2, > .25, > .3

TABLE VI-6

FINANCIAL DATA FOR THE ELECTRIC UTILITY SAMPLE

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1]	CF/TL[2]	TL/NW[3]	CURRAT[4]	QRAT[5]
Black Hills Power and Light	1977(x-1) 1976(x-2) 1975(x-3)	3.7 3.2 3.0	6.7 5.3 4.9	4.3 2.5 2.3	6.5 3.6 3.8	14.5 11.5 11.6	84.6 55.7 40.8	38.8 38.4 27.4	123.4 94.1 68.2	P P P	F F 12.0	F 1.45 1.49	F F F	F F F
Boston Edison	1977(x-1) 1976(x-2) 1975(x-3)	37.6 39.8 33.8	82.5 82.7 72.2	105.0 91.0 95.0	126.0 112.0 112.0	177.0 155.0 163.0	948.0 899.0 878.0	520.0 473.0 432.0	1468.0 1372.0 1310.0	P P P	F F F	1.82 1.90 F	F F F	F F F
Carolina Power and Light	1977(x-1) 1976(x-2) 1975(x-3)	121.0 111.0 92.2	192.1 173.4 138.8	91.0 61.0 56.0	181.0 123.0 140.0	120.0 102.0 91.0	1542.0 1411.0 1356.0	1186.0 1145.0 1049.0	2778.0 2556.0 2405.0	P P P	12.5 12.3 10.2	1.30 1.23 1.29	1.51 F 1.54	F F F
Central Hudson Gas and Electric	1977(x-1) 1976(x-2) 1975(x-3)	17.8 15.9 14.4	31.1 28.8 27.0	27.3 24.3 20.0	41.9 37.8 31.8	51.4 47.8 30.8	233.0 229.0 214.0	186.0 167.0 162.0	419.0 396.0 376.0	P P P	13.4 12.6 12.6	1.25 1.37 1.32	F F F	F F F
Central Illinois Light Company	1977(x-1) 1976(x-2) 1975(x-3)	21.6 23.5 18.0	49.2 46.7 36.9	58.0 54.0 51.0	81.0 70.0 72.0	63.0 87.0 106.0	490.0 484.0 451.0	288.0 252.0 230.0	758.0 736.0 681.0	P P P	10.0 F F	1.70 1.92 1.96	F F F	F F F
Central Illinois Public Service Co.	1977(x-1) 1976(x-2) 1975(x-3)	37.1 30.6 27.8	63.8 54.7 49.6	63.0 34.0 35.0	102.0 60.0 59.0	98.0 62.0 77.0	629.0 518.0 465.0	389.0 322.0 288.0	1018.0 840.0 753.0	P P P	10.1 10.6 10.7	1.62 1.61 1.61	F F F	F F F
Central Louisiana Electric Co.	1977(x-1) 1976(x-2) 1975(x-3)	25.8 25.5 22.2	40.6 38.7 33.5	58.0 38.0 30.0	71.0 46.0 39.0	95.0 47.0 44.0	329.0 275.0 245.0	190.0 179.0 167.0	519.0 454.0 412.0	P P P	12.3 14.1 13.7	1.73 1.54 1.47	F F F	F F F
Central Maine Power	1977(x-1) 1976(x-2) 1975(x-3)	21.0 16.9 14.7	35.7 30.2 27.0	36.0 28.0 34.0	51.0 42.0 48.0	65.0 47.0 41.0	326.0 301.0 260.0	238.0 185.0 169.0	564.0 486.0 429.0	P P P	11.0 10.0 10.4	1.37 1.63 1.54	F F F	F F F
Con Edison of New York	1977(x-1) 1976(x-2) 1975(x-3)	323.6 301.4 251.4	493.2 466.3 406.7	876.0 796.0 689.0	1031.0 953.0 826.0	436.0 360.0 270.0	3552.0 3539.0 3424.0	3206.0 3050.0 2891.0	6758.0 6589.0 6315.0	P P P	13.9 13.2 11.9	1.11 1.16 1.18	P P P	P P P
El Paso Electric	1977(x-1) 1976(x-2) 1975(x-3)	11.4 11.5 10.1	17.9 20.7 15.4	31.0 21.0 25.0	40.0 32.0 35.0	65.0 44.0 43.0	222.0 161.0 158.0	109.0 97.0 83.0	331.0 258.0 241.0	P P P	F 12.9 F	F 1.66 1.90	F F F	F F F
Empire District Electric Co.	1977(x-1) 1976(x-2) 1975(x-3)	5.9 4.3 3.9	10.6 8.6 8.0	11.0 7.0 4.0	16.0 11.0 7.0	124.0 104.0 97.0	84.0 69.0 65.0	60.0 50.0 40.0	144.0 119.0 105.0	P P P	12.6 12.5 12.3	1.40 1.38 1.63	F F F	F F F

[1] P < 10.0 (passes all tests); F > 20.0 (fails all tests)

[2] P > 20.0 (passes all tests); F < 10.0 (fails all tests)

[3] P < 1.0 (passes all tests); F > 2.0 (fails all tests)

[4] P > 2.0 (passes all tests); F < 1.5 (fails all tests)

[5] P > 1.2 (passes all tests); F < 1.0 (fails all tests)

Reproduced from best available copy.

TABLE VI-6 (Continued)

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1/]	CF/TL[2/]	TL/NW[3/]	CURRAT[4/]	QRAT[5/]
Florida Power and Light	1977(x-1)	180.4	305.4	105.0	237.0	237.0	314.0	2536.0	4072.0	P	12.0	1.65	F	F
	1976(x-2)	116.8	205.3	142.0	264.0	274.0	2417.0	1450.0	3867.0	P	F	1.67	F	F
	1975(x-3)	145.2	227.5	102.0	210.0	282.0	2149.0	1269.0	3418.0	P	1.06	1.69	F	F
General Public Utility Corp.	1977(x-1)	142.8	240.0	156.0	261.0	190.0	2478.0	1827.0	4305.0	P	F	1.36	F	F
	1976(x-2)	121.2	209.6	163.0	238.0	188.0	2352.0	1643.0	3955.0	P	F	1.43	F	F
	1975(x-3)	107.4	190.8	142.0	209.0	155.0	2061.0	1584.0	3645.0	P	F	1.30	F	F
Ohio Edison	1977(x-1)	111.6	170.2	119.0	190.0	148.0	1277.0	1166.0	2443.0	P	13.3	1.10	F	F
	1976(x-2)	103.2	151.2	79.0	136.0	126.0	1147.0	934.0	2081.0	P	13.2	1.23	F	F
	1975(x-3)	83.4	123.5	58.0	107.0	204.0	1031.0	805.0	1836.0	P	12.0	1.28	F	F
Pennsylvania Power and Light	1978(x-1)	149.0	222.1	NA	291.0	364.0	1814.0	1525.0	3339.0	P	12.2	1.19	F	F
	1977(x-2)	149.8	217.8	NA	330.0	215.0	1704.0	1346.0	3050.0	P	12.8	1.27	1.53	NA
	1976(x-3)	112.1	174.6	NA	259.0	211.0	1503.0	1164.0	2667.0	P	11.6	1.29	F	NA
Peoples Gas Co.	1978(x-1)	130.5	254.7	NA	581.0	449.0	1882.0	924.0	2806.0	P	13.5	F	F	NA
	1977(x-2)	115.7	229.6	NA	418.0	369.0	1639.0	858.0	2497.0	P	14.0	1.91	F	NA
	1976(x-3)	113.0	216.9	NA	290.0	345.0	1592.0	744.0	2336.0	P	13.6	F	F	F
Philadelphia Electric Company	1978(x-1)	184.9	301.4	NA	363.0	292.0	2791.0	2059.0	4850.0	P	10.8	1.36	F	NA
	1977(x-2)	173.4	281.2	NA	342.0	224.0	2577.0	1971.0	4548.0	P	10.9	1.31	1.53	NA
	1976(x-3)	164.6	261.1	NA	311.0	214.0	2356.0	1861.0	4217.0	P	11.1	1.27	F	NA
Piedmont Natural Gas	1978(x-1)	5.1	9.4	NA	36.7	30.4	109.0	50.0	159.0	P	F	F	F	NA
	1977(x-2)	5.1	9.3	NA	30.3	20.3	100.0	49.0	149.0	P	F	F	F	NA
	1976(x-3)	6.3	10.5	NA	23.2	28.8	89.0	49.0	138.0	P	11.8	1.81	F	F
Pioneer Corporation	1978(x-1)	34.0	59.2	NA	155.0	116.0	321.0	173.0	494.0	P	18.4	1.85	F	NA
	1977(x-2)	38.2	59.0	NA	136.0	106.0	258.0	161.0	419.0	P	P	1.60	F	NA
	1976(x-3)	38.0	56.4	NA	135.0	96.0	247.0	136.0	383.0	P	P	1.82	F	NA
Portland General Electric	1978(x-1)	56.6	82.2	NA	81.4	186.4	984.0	633.0	1617.0	P	F	1.55	F	F
	1977(x-2)	37.0	59.7	NA	61.8	116.8	774.0	568.0	1342.0	P	F	1.3	F	F
	1976(x-3)	52.0	59.2	NA	58.7	126.7	685.0	495.0	1180.0	P	F	1.38	F	F
Potomac Electric Power Co.	1978(x-1)	78.8	137.9	NA	195.0	149.0	1287.0	827.0	2114.0	P	10.7	1.56	F	NA
	1977(x-2)	84.9	141.9	NA	234.0	160.0	1286.0	773.0	2059.0	P	11.0	1.66	F	NA
	1976(x-3)	77.0	131.6	NA	156.0	189.0	1093.0	753.0	1846.0	P	12.0	1.45	F	F
Public Service Co. of Colorado	1978(x-1)	57.7	102.4	NA	194.0	184.0	933.0	720.0	1653.0	P	11.0	1.30	F	NA
	1977(x-2)	51.0	92.5	NA	170.0	148.0	830.0	664.0	1494.0	P	11.1	1.25	F	NA
	1976(x-3)	54.7	94.0	NA	159.0	127.0	786.0	615.0	1401.0	P	12.0	1.28	F	NA
Public Service Co. of Indiana	1978(x-1)	87.7	140.7	NA	223.0	187.0	1219.0	825.0	2044.0	P	11.5	1.48	F	NA
	1977(x-2)	88.5	134.2	NA	162.0	141.0	1026.0	699.0	1725.0	P	13.1	1.47	F	NA
	1976(x-3)	75.0	117.5	NA	-23.0	169.0	841.0	617.0	1458.0	P	14.0	1.36	F	F
Public Service Co. of New Hampshire	1978(x-1)	36.5	51.3	NA	72.0	174.0	500.0	[illegible]	812.0	P	10.3	1.60	F	F
	1977(x-2)	21.7	35.8	NA	61.0	95.0	365.5	275.0	640.0	P	F	1.33	F	F
	1976(x-3)	21.0	34.8	NA	62.0	42.0	310.0	230.0	540.0	P	11.2	1.34	F	NA

TABLE VI-6 (Concluded)

Name of Firm	Year	NI	CF	QA	CA	CL	TL	NW	TA	NFA/TA[1]	CF/TL[2]	TL/NW[3]	CURRAT[4]	QRAT[5]
San Diego Gas and Electric	1978(x-1)	66.8	102.4	NA	199.0	163.0	860.0	694.0	1554.0	P	11.9	1.24	F	NA
	1977(x-2)	60.2	92.8	NA	187.0	213.0	831.0	582.0	1413.0	P	11.2	1.43	F	F
	1976(x-3)	50.5	80.5	NA	146.0	181.0	706.0	481.0	1187.0	P	11.4	1.47	F	F
Savannah Electric Power Co.	1978(x-1)	11.4	17.4	NA	15.8	16.7	169.0	79.0	248.0	P	10.3	F	F	F
	1977(x-2)	8.7	14.3	NA	11.1	11.0	134.0	73.0	207.0	P	10.7	1.84	F	NA
	1976(x-3)	6.4	11.2	NA	10.8	8.7	127.0	63.0	190.0	P	F	F	F	NA

TABLE VI-7

APPLICABILITY OF FINANCIAL TESTS TO UTILITIES
(26 Firm Samples)

Single Ratio Tests	A_{NBU}[1] (One-Year Eligibility Requirement)	A_{NBU} (Three-Year Eligibility Requirement)
CF/TL > .1	77	54
CF/TL > .15	4	4
CF/TL > .2	0	0
TL/NW < 2.0	81	77
TL/NW < 1.5	46	38
TL/NW < 1.2	12	4
TL/NW < 1.0	0	0
NI/TA > .02	100	100
NI/TA > .25	54	46
NWK/TA > .25	0	0
CURRAT > 1.5	12	8
CURRAT > 2.0	4	4
QRAT > 1.0	8	4
QRAT > 1.2	4	4
NFA/TA > .25	100	100
NFA/TA > .3	100	100

---

[1] A_{NBU} = Percent of viable utilities passing a given test.

Given this reduced list of acceptable parameters, only 28 of the 151 multi-ratio tests were classified as applicable to utilities. These tests were then evaluated against the utility sample, with the results summarized in Table VI-8 and VI-9. For many of the higher E_p score values, the tests that can be effectively applied to utilities are also those which are most effective for other industries. If, however, a greater than 90 percent reduction in the overall rate of large firm bankruptcy is sought, the tests which permit an acceptable percentage of utilities to pass also reject a higher percentage of other viable firms. This disparity is illustrated in Figure VI-1, which contrasts one-year tests on the performance curve with utility applicable tests, using only tests applicable to utilities derived in Section V.

C. Hazardous Waste Management Firms

Because the majority of firms currently in the hazardous waste management business are either privately held or single-site entities with assets less than $1 million (Foster D. Snell, 1976), it was not possible to assemble a sample of hazardous waste management firms which could be used to evaluate test applicability.

Table VI-10 shows average ratios for hazardous waste management firms from 1971-1975. These ratios suggest that the average hazardous waste management firm would have little difficulty with possible net fixed assets to total assets requirements. However the average firm in this industry would have had trouble in many of these years with possible current ratio and total liability to net worth requirements. The average profits to total debt ratio suggests an uncertain picture with

TABLE VI- 8

OVERALL EFFECTIVENESS OF UTILITY-APPLICABLE FINANCIAL TESTS

(One-Year Eligibility Requirement)

Test Number	Test Description	E_P	A_{NB}	A_{NBU}
	Pass All:			
11	CF/TL > .1 TL/NW < 1.5	6.1	77	42
12	CF/TL > .1 TL/NW < 2.0	6.8	81	69
15	NI/TA > .04 TL/NW < 1.5	6.3	66	31
16	NI/TA > .04 TL/NW < 2.0	7.3	72	46
19	NI/TA > .02 TL/NW < 1.5	6.5	77	46
20	NI/TA > .02 TL/NW < 2.0	7.4	82	81
	2 out of 3:			
97	CF/TL > .1 TL/NW < 1.5 CURRAT > 2.0	9.7	86	42
98	CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	9.3	93	69
99	CF/TL > .1 TL/NW < 1.5 CURRAT > 1.5	10.1	91	42
100	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	10.1	96	69
109	CF/TL > .1 TL/NW < 1.5 QRAT > 1.2	8.3	82	42
110	CF/TL > .1 TL/NW < 2.0 QRAT > 1.2	8.4	87	69

TABLE VI-8 (Continued)

Test Number	Test Description	E_P	A_{NB}	A_{NBU}
119	CF/TL > .1 TL/NW < 1.5 QRAT > 1.0	9.5	88	42
120	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	9.1	92	69
	Pass All:			
123	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	3.3	55	42
124	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	3.1	59	69
125	NFA/TA > .25 CF/TL > .1 TL/NW < 1.5	2.9	62	42
126	NFA/TA > .25 CF/TL > .1 TL/NW < 2.0	3.6	66	69
127	NFA/TA > .2 CF/TL > .1 TL/NW < 2.0	3.8	75	69
	2 out of 3:			
130	NFA/TA > .3 CF/TL > .2 TL/NW < 1.5	7.1	73	46
133	NFA/TA > .3 CF/TL > .15 TL/NW < 1.5	6.8	80	46
134	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	4.6	79	77
135	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	5.6	83	77

TABLE VI-8 (Concluded)

Test Number	Test Description	E_P	A_{NB}	A_{NBU}
136	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	7.9	89	81
137	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	9.1	92	88
146	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	9.9	95	77
	3 out of 4:			
149	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0 TL/NW < 1.5	6.0	87	69
150	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0 TL/NW < 2.0	5.5	81	42

TABLE VI-9

OVERALL EFFECTIVENESS OF UTILITY-APPLICABLE FINANCIAL TESTS

(Three-Year Eligibility Requirement)

Test Number	Test Description	E_P	A_{NB}	A_{NBU}
	Pass All:			
11	CF/TL > .1 TL/NW < 1.5	3.7	70	35
12	CF/TL > .1 TL/NW < 2.0	5.2	76	58
15	NI/TA > .04 TL/NW < 1.5	4.7	56	<20
16	NI/TA > .04 TL/NW < 2.0	6.1	60	23
19	NI/TA > .02 TL/NW < 1.5	4.9	69	38
20	NI/TA > .02 TL/NW < 2.0	6.6	75	77
	2 out of 3:			
97	CF/TL > .1 TL/NW < 1.5 CURRAT > 2.0	7.7	75	35
98	CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	8.6	82	58
99	CF/TL > .1 TL/NW < 1.5 CURRAT > 1.5	8.2	80	35
100	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	9.7	84	58
109	CF/TL > .1 TL/NW < 1.5 QRAT > 1.2	6.5	72	35
110	CF/TL > .1 TL/NW < 2.0 QRAT > 1.2	7.4	78	58

TABLE VI-9 (Continued)

Test Number	Test Description	E_P	A_{NB}	A_{NBU}
119	CF/TL > .1 TL/NW < 1.5 QRAT > 1.0	8.0	78	35
120	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	8.2	83	58
	Pass All:			
123	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	1.6	49	35
124	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	1.5	53	58
125	NFA/TA > .25 CF/TL > .1 TL/NW < 1.5	1.4	56	35
126	NFA/TA > .25 CF/TL > .1 TL/NW < 2.0	2.2	59	58
127	NFA/TA > .2 CF/TL > .1 TL/NW < 2.0	1.9	67	58
	2 out of 3:			
130	NFA/TA > .3 CF/TL > .2 TL/NW < 1.5	4.9	64	38
133	NFA/TA > .3 CF/TL > .15 TL/NW < 1.5	4.7	72	42
134	NEA/TA > .3 CF/TL > .1 TL/NW < 1.0	2.9	72	62
135	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	4.1	77	62

TABLE VI-9 (Concluded)

Test Number	Test Description	E_P	A_{NB}	A_{NBU}
136	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	5.4	82	65
137	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	7.3	86	81
146	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	9.5	83	62
	3 out of 4:			
149	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0 TL/NW < 1.5	5.0	74	58
150	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0 TL/NW < 2.0	4.1	71	35

FIGURE VI-1

PERFORMANCE CURVE FOR TESTS WITH ONE-YEAR ELIGIBILITY REQUIREMENTS
WITH AND WITHOUT UTILITY APPLICABLE TESTS

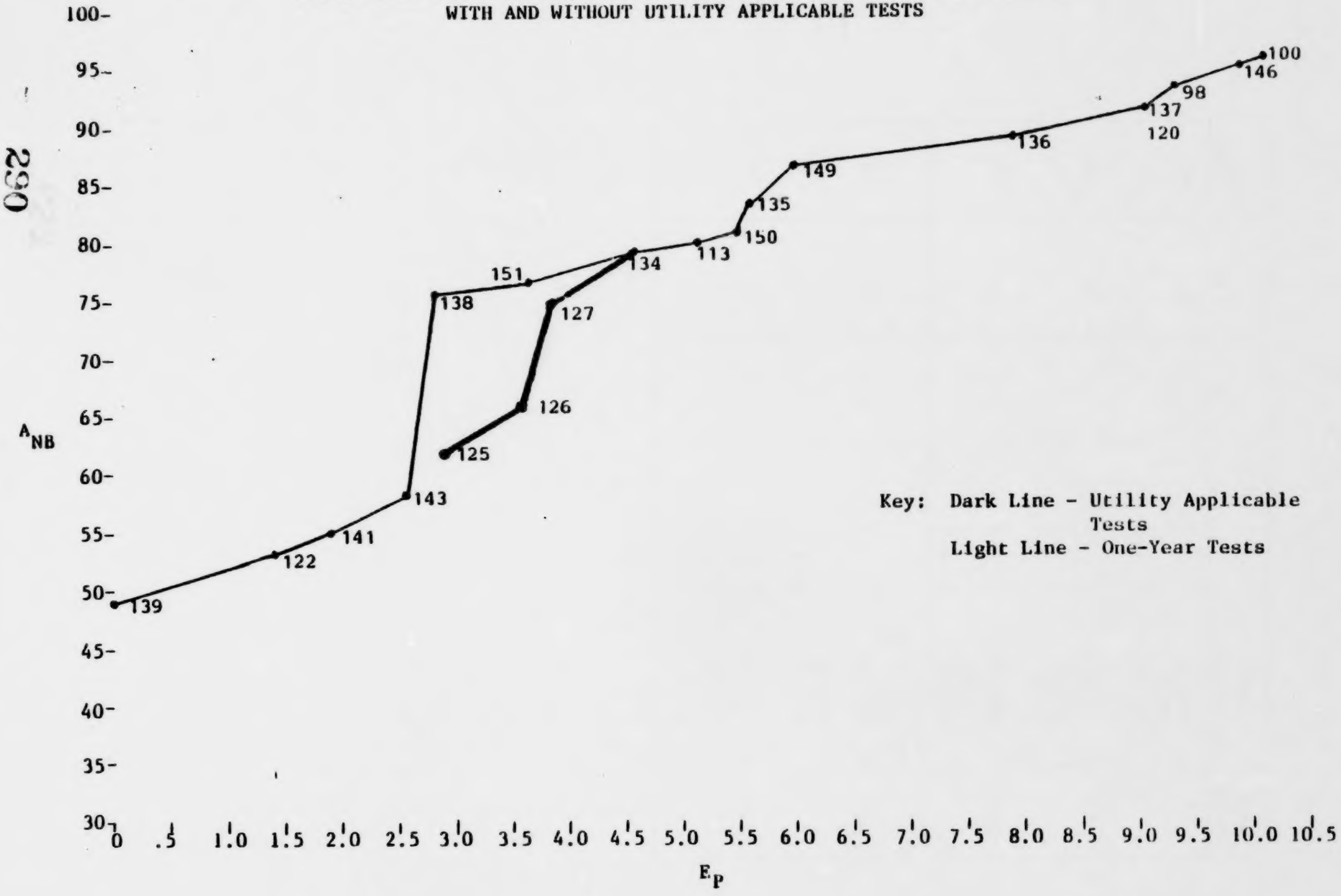


TABLE VI-10

AVERAGE RATIOS OF HAZARDOUS WASTE MANAGEMENT FIRMS, 1971-1975

	1971	1972	1973	1974	1975
Current Ratio					
a. Firms whose main objective is hazardous waste management	1.58	1.77	1.42	1.33	1.28
b. Corporations having divisions or sites engaged in hazardous waste management	1.28	1.61	1.81	2.04	1.83
Total Debt/Equity					
a. Firms whose main objective is hazardous waste management	1.20	1.19	1.18	1.60	1.64
b. Corporations having divisions or sites engaged in hazardous waste management	1.37	1.66	2.43	1.96	NA
Profits/Total Debt					
a. Firms whose main objective is hazardous waste management	NA	.096	.102	.134	.182
b. Corporations having divisions or sites engaged in hazardous waste management	.127	.098	.056	.076	.075
Net Fixed Assets/Total Assets					
a. Firms whose main objective is hazardous waste management	.65	.64	.62	.555	.60
b. Corporations having divisions or sites engaged in hazardous waste management	.62	.57	.63	.60	.62

SOURCE: Foster D. Snell, 1976.

respect to the ability of the average firm in the industry to meet the possible cash flow/total liability requirements. This ability would depend in at least some years on total depreciation, amortization and depletion allowance.

Thus, firms in the hazardous waste management industry could be expected to have difficulty meeting many possible financial tests even without a $10 million in net worth requirement. However, this reflects the financial weakness of this industry during this period rather than some unique financial feature of the industry. The study from which the ratios in Table VI-10 are drawn states:

> Since 1973, long term debt has remained stable for the industry as financial institutions have been reluctant to invest capital in the industry because: hazardous waste management firms in general did not have strong financial positions, and the growth of the industry was deemed risky in future periods. Short debt financing has increased from $3.2 million in 1971 to $7.2 million in 1975. This high cost debt financing additionally points out the current problems of the industry in obtaining lower cost long-term capital. (Foster D. Snell, 1976).

The share of hazardous waste facilities owned by hazardous waste management firms with over $10 million in net worth and independently audited is small. Only 26 facilities are owned by the four largest hazardous waste management firms which are independently audited. The next eight to nine largest firms are all privately held and are unlikely to be independently audited. The majority of off-site facilities are owned by relatively small firms with less than $10 million in net worth (Booz, Allen & Hamilton and Putnam, Hayes & Bartlett, 1980). The 26 facilities which are owned by large, independently audited firms thus represent only about 1 percent of the 2,500 facilities owned by firms eligible for a financial test.

A careful examination of the balance sheets of two of the larger firms in the industry which own 12 of the 26 facilities, Browning Ferris Industries (BFI) and SCA Services, Inc. showed their performance with respect to the relevent ratios as summarized in Table VI-11. BFI would pass 13 of the 16 financial tests on the performance curve for tests with one-year or three-year elibibility requirements. SCA would pass 12 of these 16 tests.

TABLE VI-11

RATIOS FOR BROWNING FERRIS INDUSTRIES (BFI) AND SCA SERVICES, INC.

Firm Name	Year of Data	CF/TL	TL/NW	NFA/TA	CURRAT	QRAT	NI/TA
BFI	(x-1) 1978	17.5	1.13	P[1]	1.60	P	P
	(x-2) 1977	15.5	1.10	P	F[2]	P	P
	(x-3) 1976	15.7	1.12	P	1.64	P	P
SCA	(x-1) 1978	15.4	1.52	P	1.65	P	4.0
	(x-2) 1977	14.9	1.55	P	F	P	3.0

[1] P = Passes all tests using this variable.

[2] F = Fails all tests using this variable.

VII. BOND RATINGS

Several commenters on the May 19, 1980 reproposed financial responsibility regulations suggested that corporate bond ratings should be used as an alternative or substitute for the proposed financial test. The Agency therefore analyzed the possibility of using corporate bond ratings as an assurance of financial responsibility.

Bonds are a form of long-term debt. They may be unsecured, or secured by collateral such as equipment, marketable securities, or fixed assets. Certain bonds include specific promises concerning the use of special sinking funds. Repayment of other categories of bonds may be subordinated to repayment of other debt instruments.

Bond ratings provide an appraisal of the ability of firms to repay these long-term debts. They are used extensively by the financial community for the purpose of providing a long-term credit risk evaluation of the relative likelihood of timely payment of interest and repayment of principal of specific bond instruments. Many banks, including large ones, rely almost exclusively on rating service evaluations of bonds and do not have internal groups which independently evaluate the riskiness of their bond portfolios (Kaplan and Urwitz, 1979). Because bond ratings measure the ability of firms to meet a long-term debt, they are better adapted to an analysis of long-term financial responsibility than are ratings of short-term credit and trade credit.

The Agency did not attempt to evaluate the performance of ratings of specific types of bonds. Rather, it considered the ratings performance of all categories of long-term debt that were (1) identified as bonds by either of the two major bond ratings services and (2) rated by either of them.

The two major ratings services are Moody's Investors Services, Inc. (Moody's) and Standard and Poor's Corporation (Standard and Poor's). Each has long experience in rating corporate bonds. Moody's and Standard and Poor's rate almost all corporate bond issues of $5 million and over in principal amount with or without request from the issuer. The bonds of certain issuers (including newly created companies in most cases) are not rated, and ratings of other issuances are carried out only upon request and are not published except upon permission of the issuer.

Both major ratings services provide nine basic ratings of corporate bonds. Figure VII-1 provides a listing of the ratings given by Moody's and the interpretation of each rating as suggested by Moody's. Figure VII-2 provides the ratings and their interpretations used by Standard and Poor's. The ratings classifications are highly qualitative, and neither rating service suggests any specific quantitative equivalent for the ratings assigned.

The top four ratings of both services are assigned to bonds considered to be of investment grade, while the remaining ratings are assigned to bonds that are considered to be speculative. Ratings of each bond issuance are reviewed periodically and may be upgraded or downgraded. Table VII-1 provides a distribution of corporate bond ratings issued by

Aaa

Bonds which are rated Aaa are judged to be of the best quality. They carry the smallest degree of investment risk and are generally referred to as "gilt edge." Interest payments are protected by a large or by an exceptionally stable margin and principal is secure. While the various protective elements are likely to change, such changes as can be visualized are most unlikely to impair the fundamentally strong position of such issues.

Aa

Bonds which are rated Aa are judged to be of high quality by all standards. Together with the Aaa group they comprise what are generally known as high grade bonds. They are rated lower than the best bonds because margins of protection may not be as large as in Aaa securities or fluctuation or protective elements may be of greater amplitude or there may be other elements present which make the long term risks appear somewhat larger than in Aaa securities.

A

Bonds which are rated A possess many favorable investment attributes and are to be considered as upper medium grade obligations. Factors giving security to principal and interest are considered adequate but elements may be present which suggest a susceptibility to impairment sometime in the future.

Baa

Bonds which are rated Baa are considered as medium grade obligations, i.e., they are neither highly protected nor poorly secured. Interest payments and principal security appear adequate for the present but certain protective elements may be lacking or may be characteristically unreliable over any great length of time. Such bonds lack outstanding investment characteristics and in fact have speculative characteristics as well.

Ba

Bonds which are rated Ba are judged to have speculative elements; their future cannot be considered as well assured. Often the protection of interest and principal payments may be very moderate and thereby not well safeguarded during both good and bad times over the future. Uncertainty of position characterizes bonds in this class.

B

Bonds which are rated B generally lack characteristics of the desirable investment. Assurance of interest and principal payments or of maintenance of other terms of the contract over any long period of time may be small.

Caa

Bonds which are rated Caa are of poor standing. Such issues may be in default or there may be present elements of danger with respect to principal or interest.

Ca

Bonds which are rated Ca represent obligations which are speculative in a high degree. Such issues are often in default or have other marked shortcomings.

C

Bonds which are rated C are the lowest rated class of bonds and issues so rated can be regarded as having extremely poor prospects of ever attaining any real investment standing.

Reproduced from
best available copy.

FIGURE VII-1

KEY TO MOODY'S BOND RATINGS

Reproduced from best available copy.

A Standard & Poor's corporate or municipal bond rating is a current assessment of the creditworthiness of an obligor with respect to a specific debt obligation. This assessment may take into consideration obligors such as guarantors, insurers, or lessees.

The bond rating is not a recommendation to purchase, sell, or hold a security inasmuch as it does not comment as to market price or suitability for a particular investor.

The ratings are based on current information furnished by the issuer or obtained by Standard & Poor's from other sources we consider reliable. We do not perform an audit in connection with any rating and may, on occasion, rely on unaudited financial information. The ratings may be changed, suspended, or withdrawn as a result of changes in, or unavailability of, such information, or for other reasons.

The ratings are based, in varying degrees, on the following considerations:

I. Likelihood of default—capacity and willingness of the obligor as to the timely payment of interest and repayment of principal in accordance with the terms of the obligation

II. Nature of and provisions of the obligation

III. Protection afforded by, and relative position of, the obligation in the event of bankruptcy, reorganization, or other arrangement under the laws of bankruptcy and other laws affecting creditor's rights

AAA Bonds rated AAA have the highest rating assigned by Standard & Poor's to a debt obligation. Capacity to pay interest and repay principal is extremely strong.

AA Bonds rated AA have a very strong capacity to pay interest and repay principal and differ from the highest-rated issues only in a small degree.

A Bonds rated A have a strong capacity to pay interest and repay principal, although they are somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than bonds in higher-rated categories.

BBB Bonds rated BBB are regarded as having an adequate capacity to pay interest and repay principal. Although they normally exhibit adequate protection parameters, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal for bonds in this category than for bonds in higher-rated categories.

BB B CCC CC Bonds rated BB, B, CCC, and CC are regarded, on balance, as predominantly speculative with respect to capacity to pay interest and repay principal in accordance with the terms of the obligation. BB indicates the lowest degree of speculation and CC the highest degree of speculation. While such bonds will likely have some quality and protective characteristics, these are outweighed by large uncertainties or major risk exposures to adverse conditions.

C The rating C is reserved for income bonds on which no interest is being paid.

D Bonds rated D are in default, and payment of interest and/or repayment of principal is in arrears.

Plus (+) or Minus (−): The ratings from AA to BB may be modified by the addition of a plus or minus sign to show relative standing within the major rating categories.

Provisional Ratings: The letter "p" indicates that the rating is provisional. A provisional rating assumes the successful completion of the project financed by the bonds being rated and indicates that payment of debt service requirements is largely or entirely dependent upon the successful and timely completion of the project. This rating, however, while addressing credit quality subsequent to completion of the project, makes no comment on the likelihood of, or the risk of default upon failure of, such completion. The investor should exercise his or her own judgment with respect to such likelihood and risk.

NR Indicates that no rating has been requested, that there is insufficient information on which to base a rating, or that Standard & Poor's does not rate a particular type of obligation as a matter of policy.

Debt obligations of issuers outside the United States and its territories are rated on the same basis as domestic corporate and municipal issues. The ratings measure the creditworthiness of the obligor, but do not take into account currency exchange and other uncertainties.

Bond Investment Quality Standards: Under present commercial bank regulations issued by the Comptroller of the Currency, bonds rated in the top four categories (AAA, AA, A, BBB, commonly known as "investment grade" ratings) are generally regarded as eligible for bank investment. In addition, the legal investment laws of various states impose certain ratings or other standards for obligations eligible for investment by savings banks, trust companies, insurance companies, and fiduciaries generally.

FIGURE VII-2

STANDARD & POOR'S CORPORATE RATING DEFINITIONS

TABLE VII-1

PERCENTAGE DISTRIBUTION OF PUBLICLY OFFERED STRAIGHT CORPORATE BONDS

Amount	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975[1]
in billions	7.8	14.8	10.9	9.5	23.1	21.3	12.3	12.3	24.8	31.1
Aaa & Aa	48%	42%	48%	53%	50%	53%	60%	61%	64%	57%
A	19	19	17	27	38	32	28	29	29	36
Baa & below	27	30	23	20	11	11	8	5	6	7
Not rated	6	9	12	0	1	1	4	5	1	3

[1] 11 months.

SOURCE: Backer and Gosman (1978).

Moody's for recent years. Table VII-2 shows the number of outstanding bond issues rated by Moody's at a point in time in July 1981. According to this Table, 86 percent of the outstanding bond issues rated by Moody's as of that time would be acceptable for satisfying the bond rating portion of the financial test.

Both ratings services insist that a bond rating is based on the specific bond instrument in question, and does not imply a rating for other instruments of the firm or a rating of the firm as a whole. This is due, in part, to the fact that different bonds are secured by different types and amounts of collateral, and by different types of other so-called "structural credit supports" such as third party guarantees, segregated cash flow, or insurance. However, the rating agencies do carry out an analysis of the situation of both the industry and of the company within the industry and a financial analysis of the company, and these analyses also affect the rating assigned to the specific bond instrument.

According to Standard and Poor's Ratings Guide, ratings are based, to varying degrees, on the following considerations:

> I. Likelihood of default--capacity and willingness of the obligor as to the timely payment of interest and repayment of principal in accordance with the terms of the obligation
>
> II. Nature of and provisions of the obligation
>
> III. Protection afforded by, and relative position of, the obligation in the event of bankruptcy, reorganization, or other arrangement under the laws of bankruptcy and other laws affecting creditor's rights
>
> (Standard and Poor's Ratings Guide, 1979)

TABLE VII-2

OUTSTANDING BOND ISSUES*
JULY 1981

Moody's Ratings	Number of Issues	Percentage of Issues
Investment Grade		
Aaa	750	13
Aa	1140	20
A	2029	35
Baa	1012	18
Total Investment Grade	4931	86
Below Investment Grade		
Ba	339	6
B	320	6
Caa	95	2
Ca	38	1
C	10	0
Total Below Investment Grade	802	15

*Includes: Industrials, Utilities, Transportation, Banks and Finance Companies.

Note: Totals may exceed 100% due to rounding error.

SOURCE: Ron Lewis of Moody's Corporate Bond Department.

The wide scope of bond rating agency analysis can be better appreciated from the description given by Brenton W. Harris, a former President of Standard and Poor's, when listing the factors used as a basis for assigning bond ratings:

1. Issuing documents: ... In determining a rating, the indenture is far less important than the company's earning power, financial resources, and property protection. This is not to say, however, that the indenture does not have a great bearing on a bond rating...

2. Earnings: the past record and foreseeable potential are, in most cases, the single most important factor in credit rating. High levels of earnings frequently preclude liquidity problems because access to short-term cash needs can be readily accommodated. Remembering that bond ratings turn on timely repayment of principal and interest, strong cash flows generated by high and continued earnings, combined with an adequate depreciation, depletion, and amortization policy where applicable, contribute a healthy plus factor to the determination of a bond rating...

3. Asset protection: Asset protection generally is more important as a long-term consideration than as one influencing immediate liquidity. The analysis here is primarily statistical and, hence, highly objective. Of primary interest are the ratio of its working capital to its debt; the ratio of its debt to its equity; and the ratio of its total net tangible assets to its debt. The relative importance of these major ratios depends on the type of industry the company is in...

4. Management: Evaluating management is one of the most difficullt chores a rating agency faces. But management is one of the most important facets of a successful operation. It is my opinion that the single most important reason for the failure of the Penn Central was the inability of its management to deal with its problems...

5. Financial resources are, of course, the largest single area in which liquidity has a direct impact on long-term debt rating. In looking at the financial resources of a company, we are concerned not only with a company's cash position but also with its ability to obtain cash. This area of financial resources, which constitutes one of the five fundamental areas of investigation to determine

> long-term debt rating, is the test of liquidity ... Briefly stated, the financial resources we consider are those alternative sources of borrowing that a firm may use to raise cash for either long- or short-term debt repayment. They include the amount of cash reserves on hand including salable receivables; the short-term borrowing potential, particularly bank lines; the ability of the company to tap the long-term debt market, particularly at the time of its choosing; the ease with which the company could sell stock; and the potential sale of assets--obviously the weakest alternative.
>
> (Quoted in Backer and Gosman, 1978)

The Agency is satisfied that the actual establishment of a rating is the result of the informed judgment of trained analysts based on a detailed study of all of the above factors, and does not involve the mechanical application of formulae. Bond ratings are therefore a different type of analysis of financial liability than a financial test. Spokesmen for the ratings services emphasize the point that bond ratings are based on expert judgment (Backer and Gosman, 1978). Although some investigators have questioned this assertion (Ross 1976, Sherwood 1976), arguing that bond ratings services rely on explicit cutoff points of particular financial ratios, a thorough recent study of bond and other financial ratings procedures prepared for the National Association of Accountants reported, with respect to the importance of financial ratios in credit rating evaluations, that:

> All interviewees stated the belief that financial ratios were of moderate to strong importance in their credit rating evaluations. However, almost all those interviewed cautioned that such financial measures were not the only thing of importance; additional considerations frequently mentioned included quality of management, future for product, and general economic conditions. (Backer and Gosman, 1978).

The same study conducted a statistical analysis to determine which ratios seemed to be most important by comparing a group of bonds that had not been downgraded and group of bonds that had been downgraded. The most statistically significant ratio was found to be cash flow to long-term debt. However, the statistical results also indicated that a number of other ratios could also be of some importance: return on sales, return on total assets, return on tangible net worth, long-term debt to capitalization, net tangible assets to long-term debt, long-term debt to property and equipment, and cash flow to total debt. This statistical examination of downgraded bonds compared to bonds that were not downgraded would probably have revealed a specific formula had one existed. No such specific formula was found.

The Agency, in order to assess the actual performance of bond ratings in predicting default, first conducted a literature search for previous studies of performance. A variety of sources suggest that bond ratings can be used as a reasonably good indicator of the quality of corporate debt. (See Lev, 1974; Fraine and Mills, 1961; and Fiedler, 1971.) The only sources for detailed statistical data supporting this conclusion, however, are two studies by W.B. Hickman, Corporate Bond Quality and Investor Experience (1958), and Statistical Measures of Corporate Bond Financing Since 1900 (1960).

Although Hickman's work is somewhat dated, covering the period 1900-1943, it does examine a period of economic volatility which provides a good test of the results of ratings services. The ratings used are those assigned at the time of issue. Thus, if the bond was downgraded prior to default but after issue, this would not be reflected in these ratings. Given the volatility of the economy for the period in question, and the fact that changes in ratings are not accounted for use of these data results in a strict judgment of bond ratings. In addition, statistical analysis of the performance of bond ratings is difficult for recent periods because so few firms with rated bonds have gone bankrupt that creation of a useful sample is almost impossible. The Agency noted, for example, that none of the firms in its sample of bankrupt firms between 1966 and 1979 had an investment grade rated bond issuance.

In a study incorporating Hickman's findings, T.B. Atkinson compared prewar and postwar (through 1965) corporate bond quality. He concluded that:

> U.S. corporate bonds defaulting in the postwar period (from 1945 through 1965) averaged less than 0.1 percent of the volume of outstanding, or about one-half billion dollars in all. This compares with 1.7 percent of the outstanding bonds which defaulted during 1900-43. The postwar defaults were concentrated in bonds of the railroad industry, many of which had been outstanding before 1920 or had been refundings of the original bonds issued prior to that year. (Atkinson, 1967)

It should be noted that these percentages of outstanding bonds which defaulted include bonds of investment and speculative quality.

In order to analyze the effectiveness of agency ratings in predicting defaults, the Agency applied a general procedure similar to that used to calculate the effectiveness (E) of various financial tests. Hickman reported in his study the percentage of the total value of outstanding bonds of a particular rating defaulted upon by firms with these bonds and the percentage of the total value not defaulted. Although there is no direct evidence correlation between the default rates of bonds and firms, it was assumed that as a rough approximation the accuracy of predicting defaults on bonds is equivalent to the accuracy in identifying defaulting firms. Therefore, the percentages reported by Hickman were used in columns 1 and 2 of Table VII-3 as the equivalents of the M_P and A_{NB} measures obtained when a particular financial test is applied to the bankrupt and to the non-bankrupt firm samples developed by the Agency. Using two alternative estimates of the baseline failure rate, effectiveness measures (E) were calculated for each grade of bond ratings in the top four categories. The results of this analysis are given in Table VII-3. The first assumption is the baseline of 22 per 10,000 used earlier in this report. The second reflects the possibility that the baseline failure rate for the kinds of firms which would have rated bonds might be as low as 11 per 10,000. Public bond ratings are generally given to bond issuances from substantial firms. A significant number of large public bond issues are not rated at all. This category of unrated public debt issues has a much higher failure rate than the failure rate of those which are rated. The unrated issues are excluded from the entire rating system, and from the percentages shown in the Table.

As can be noted from the Table, the results are quite different depending upon whether one considers the ratings for public utilities, industrials, and transportation companies combined, or only the ratings for industrials (and public utilities, though they are not shown). One important reason why bond ratings, taken as a whole, did not perform

TABLE VII-3

PERFORMANCE OF AGENCY RATINGS (1900-1943)

Agency Rating	Percentage of Defaulting Firms With Rating (M_p)[1]	Percentage of Nondefaulting Firms With Rating (A_{NB})[1]	Effectiveness in Predicting Defaults Per 10,000 Firms (E) Assuming	
			Baseline Failure Rate (F) = 22/10,000[2]	Baseline Failure Rate = 11/10,000[3]
A. All Corporate Bonds Rated (Industrials, public utilities, railroads)				
I	6.6	19	7.6	3.8
II or above	17.1	46	8.5	4.3
III or above	44.3	74	13.0	6.5
IV or above[4]	72.5	94	16.8	8.3
B. Industrials Only				
I	0	13	0	0
II or above	5	33	3.3	1.7
III or above	28	66	9.5	4.7
IV or above[3]	73	93	17.3	8.6

---

[1] For this Table, it is assumed that the accuracy of predicting defaults on bonds is equivalent to the accuracy in identifying defaulting firms.

[2] Calculated as: $\frac{F(1-(1/100 \times \text{Column } 1))}{1/100 \times \text{Column } 2}$ = Effectiveness for Bond Rating

[3] Calculated as 1/2 of Column 3 .

[4] Agency ratings of IV or above represent investment grade bonds.

better during this period is that transportation company bonds, specifically those of railroads, were overrated and suffered very high failure rates, even for firms in the highest rating categories.

The column of Table VII-3 labeled "Percentage of Non-Defaulting Bonds With Rating" shows the proportion of non-defaulting bonds by dollar value included in each set of rating categories. The investment grade ratings I-IV include the vast majority of all rated bonds. They include 94 percent of all rated corporate bonds and 93 percent of all rated industrial bonds. Thus, about 6 percent of corporate bonds and 7 percent of industrial bonds are eliminated by insisting on a rating of investment grade or better. This means that over 94 percent of the dollar value of all corporate bonds rated were rated as investment grade or above.

The top two classes of investment grade ratings are much more restrictive. For all bonds, only 46 percent had one of the top two ratings, and only 19 percent had the top rating. The Agency therefore concluded that the top two bond ratings are roughly equivalent to the effectiveness of a relatively stringent financial test, assuming that the baseline failure rate is approximately 11 per 10,000 for the firms likely to use the test rather than 22 per 10,000. A rating of IV or above, in contrast, is about equivalent to the effectiveness of a less stringent test.

The Agency also performed a special study to determine the effectiveness of bond ratings as a means of financial responsibility for utilities in particular. A sample of 113 utilities was drawn from

Moody's Public Utilities Manual. All were large (greater than $10 million in net worth), and were either electric or gas utilities. The mix of bond ratings for these firms was as follows:

TABLE VII-4

UTILITY BOND RATINGS

RATING	NUMBER OF UTILITIES	PERCENTAGE OF TOTAL	PERCENTAGE OF RATED UTILITIES
Aaa	4	3.5	3.9
Aa	22	19.4	21.7
A	50	44.2	49.6
Baa	25	22.1	24.8
Unrated	12	10.7	--
	113	100.0	100.0

As can be seen, requiring that firms have Aaa or Aa ratings to pass the test would allow only 23-26 percent of utilities to pass this test. If utilities with A ratings are included, 67-75 percent of utilities would be able to pass, and a requirement that a firm have an investment grade bond rating would allow about 89 percent or more to pass the test. However, because the sample obtained did not contain any utilities with a rating lower than investment grade, the Agency could not determine the precise effect of requiring an investment grade rating.

VIII. RESULTS FOR ALL RATIO TESTS

This Section presents the Tables showing the performance of all of the ratio tests with respect to the evaluation criteria described in Section IV.A for the primary sample. Tables VIII-1 through VIII-4 give results for tests with a one-year eligibility requirement and Tables VIII-5 through VIII-8 give results for tests with a three-year eligibility requirement.

TABLE VIII-1

PERFORMANCE OF TWO-RATIO TESTS

(One-Year Eligibility Requirement)
(Tests 1-56)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
1	CF/TL > .2 TL/NW < 1.0	4.7	11.9	38	91.7*	26.1	4.8*
2	CF/TL > .2 TL/NW < 1.2	4.7	14.2	41	90.5*	26.8	5.1*
3	CF/TL > .2 TL/NW < 1.5	9.5	16.6	41	87.0	24.4	7.0
4	CF/TL > .2 TL/NW < 2.0	9.5	16.6	41	87.0	24.4	7.0
5	CF/TL > .15 TL/NW < 1.0	4.7	14.2	52	90.5*	37.8	4.0*
6	CF/TL > .15 TL/NW < 1.2	4.7	16.6	59	89.3	42.4	4.0*
7	CF/TL > .15 TL/NW < 1.5	9.5	19.0	62	85.8	43.0	5.1*
8	CF/TL > .15 TL/NW < 2.0	7.1	21.4	63	85.7	41.6	5.0*
9	CF/TL > .1 TL/NW < 1.0	4.7	16.6	58	89.3	41.4	4.1*
10	CF/TL > .1 TL/NW < 1.2	4.7	21.4	71	87.0	49.6*	4.1*
11	CF/TL > .1 TL/NW < 1.5	11.9	30.9	77	78.6	46.1	6.1
12	CF/TL > .1 TL/NW < 2.0	11.9	38.0	81	75.0	43.0	6.8
13	NI/TA > .04 TL/NW < 1.0	4.7	14.2	54	90.5*	39.8	3.9*
14	NI/TA > .04 TL/NW < 1.2	4.7	19.0	64	88.1	45.0	4.1*
15	NI/TA > .04 TL/NW < 1.5	11.9	26.1	66	81.0	39.9	6.3

TABLE VIII-1 (Continued)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
16	NI/TA > .04 TL/NW < 2.0	11.9	35.7	72	76.2	36.3	7.3
17	NI/TA > .02 TL/NW < 1.0	4.7	16.6	58	89.3	41.4	4.1*
18	NI/TA > .02 TL/NW < 1.2	4.7	21.4	71	87.0	49.6*	4.1*
19	NI/TA > .02 TL/NW < 1.5	11.9	33.3	77	77.4	43.7	6.5
20	NI/TA > .02 TL/NW < 2.0	11.9	42.8	82	72.6	39.2	7.4
21	CF/TL > .2 CURRAT > 2.0	4.7	9.5	35	92.9*	25.5	4.5*
22	CF/TL > .15 CURRAT > 2.0	4.7	14.2	54	90.5*	39.8	3.9*
23	CF/TL > .1 CURRAT > 2.0	4.7	19.0	63	88.1	44.0	4.2*
24	CF/TL > .2 CURRAT > 1.5	4.7	9.5	41	92.9*	31.5	3.8*
25	CF/TL > .15 CURRAT > 1.5	7.1	19.0	62	87.0	43.0	4.6*
26	CF/TL > .1 CURRAT > 1.5	11.9	33.3	81	77.4	47.7*	6.1
27	CF/TL > .2 QRAT > 1.2	4.7	9.5	28	92.9*	18.5	5.6*
28	CF/TL > .15 QRAT > 1.2	4.7	11.9	42	91.7*	30.1	4.3*
29	CF/TL > .1 QRAT > 1.2	4.7	16.6	50	89.4	33.4	4.7*
30	CF/TL > .2 QRAT > 1.0	4.7	9.5	44	92.9*	34.5	3.6*
31	CF/TL > .15 QRAT > 1.0	4.7	14.2	55	90.5*	40.8	3.8*

TABLE VIII-1 (Continued)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
32	CF/TL > .1 QRAT > 1.0	7.1	26.1	66	83.4	39.9	5.6*
33	TL/NW < 1.0 CURRAT > 2.0	7.1	16.6	54	88.1	37.4	4.8*
34	TL/NW < 1.2 CURRAT > 2.0	11.9	23.8	65	82.2	41.2	6.0
35	TL/NW < 1.5 CURRAT > 2.0	16.6	30.9	69	76.2	38.1	7.6
36	TL/NW < 2.0 CURRAT > 2.0	16.6	35.7	72	73.9	36.3	8.0
37	TL/NW < 1.0 CURRAT > 1.5	4.7	21.4	62	87.0	40.6	4.6*
38	TL/NW < 1.2 CURRAT > 1.5	9.5	28.5	76	81.0	47.5*	5.5*
39	TL/NW < 1.5 CURRAT > 1.5	19.0	45.2	84	67.9	38.8	8.4
40	TL/NW < 2.0 CURRAT > 1.5	23.8	57.1	91	59.6	33.9	9.8
41	TL/NW < 1.0 QRAT > 1.2	7.1	11.9	42	90.5*	30.1	5.0*
42	TL/NW < 1.2 QRAT > 1.2	7.1	19.0	49	86.9	30.0	5.9
43	TL/NW < 1.5 QRAT > 1.2	9.5	23.8	51	83.4	27.2	7.2
44	TL/NW < 2.0 QRAT > 1.2	9.5	26.1	54	82.2	27.9	7.3
45	TL/NW < 1.0 QRAT > 1.0	7.1	11.9	52	90.5*	40.1	4.0*
46	TL/NW < 1.2 QRAT > 1.0	9.5	19.0	63	85.8	44.0	5.0*
47	TL/NW < 1.5 QRAT > 1.0	14.2	26.1	68	79.8	41.9	6.5

TABLE VIII-1 (Concluded)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
48	TL/NW < 2.0 QRAT > 1.0	14.2	33.3	74	76.2	40.7	7.1
49	NI/TA > .04 CURRAT > 2.0	4.7	19.0	57	88.1	38.0	4.6*
50	NI/TA > .04 CURRAT > 1.5	9.5	30.9	73	79.8	42.1	6.1
51	NI/TA > .02 CURRAT > 2.0	4.7	26.1	64	84.6	37.9	5.3*
52	NI/TA > .02 CURRAT > 1.5	9.5	45.2	83	72.7	37.8	7.2
53	NI/TA > .04 QRAT > 1.2	4.7	14.2	46	90.5*	31.8	4.5*
54	NI/TA > .02 QRAT > 1.2	7.1	23.8	49	84.6	25.2	6.9
55	NI/TA > .04 QRAT > 1.0	4.7	19.0	62	88.1	43.0	4.2*
56	NI/TA > .02 QRAT > 1.0	7.1	30.9	67	81.0	36.1	6.2

*Exceeds performance of best single ratio tests.

TABLE VIII-2

PERFORMANCE OF THREE-RATIO TESTS: PASS ALL TO PASS

(One-Year Eligibility Requirement)
(Tests 57-88)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
57	CF/TL > .2 TL/NW < 1.0 CURRAT > 2.0	4.7	7.1	33	94.1*	25.9	3.9*
58	CF/TL > .15 TL/NW < 1.0 CURRAT > 2.0	4.7	9.5	46	92.9*	36.5	3.4*
59	CF/TL > .1 TL/NW < 1.0 CURRAT > 2.0	4.7	9.5	50	92.9*	40.5	3.1*
60	CF/TL > .2 TL/NW < 1.2 CURRAT > 2.0	4.7	9.5	34	92.9*	24.5	4.6*
61	CF/TL > .2 TL/NW < 1.5 CURRAT > 2.0	4.7	9.5	34	92.9*	24.5	4.6*
62	CF/TL > .15 TL/NW < 1.2 CURRAT > 2.0	4.7	11.9	51	91.7*	39.1	3.6*
63	CF/TL > .15 TL/NW < 1.5 CURRAT > 2.0	4.7	14.2	52	90.5*	37.8	4.0*
64	CF/TL > .1 TL/NW < 1.2 CURRAT > 2.0	4.7	11.9	59	91.7*	47.1*	3.1*
65	CF/TL > .1 TL/NW < 1.5 CURRAT > 2.0	4.7	14.2	62	90.5*	47.8*	3.4*
66	CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	4.7	19.0	62	88.1	43.0	4.2*
67	CF/TL > .1 TL/NW < 1.5 CURRAT > 1.5	7.1	23.8	76	84.6	52.2	4.5*

TABLE VIII-2 (Continued)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
68	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	7.1	33.3	80	79.8	46.7*	5.6*
69	CF/TL > .2 TL/NW < 1.0 QRAT > 1.2	4.7	7.1	27	94.1*	19.9	4.8*
70	CF/TL > .15 TL/NW < 1.0 QRAT > 1.2	4.7	9.5	36	92.9*	26.5	4.3*
71	CF/TL > .1 TL/NW < 1.0 QRAT > 1.2	4.7	9.5	38	92.9*	28.5	4.1*
72	CF/TL > .2 TL/NW < 1.2 QRAT > 1.2	4.7	9.5	28	92.9*	18.5	5.6*
73	CF/TL > .2 TL/NW < 1.5 QRAT > 1.2	4.7	9.5	28	92.9*	18.5	5.6*
74	CF/TL > .15 TL/NW < 1.2 QRAT > 1.2	4.7	11.9	41	91.7*	29.1	4.5*
75	CF/TL > .15 TL/NW < 1.5 QRAT > 1.2	4.7	11.9	41	91.7*	29.1	4.5*
76	CF/TL > .1 TL/NW < 1.2 QRAT > 1.2	4.7	14.2	45	90.5*	30.8	4.6*
77	CF/TL > .1 TL/NW < 1.5 QRAT > 1.2	4.7	14.2	46	90.5*	31.8	4.5*
78	CF/TL > .1 TL/NW < 2.0 QRAT > 1.2	4.7	16.6	47	89.3	30.4	5.0*
79	CF/TL > .2 TL/NW < 1.0 QRAT > 1.0	4.7	7.1	34	94.1*	26.9	3.8*

TABLE VIII-2 (Concluded)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
80	CF/TL > .15 TL/NW < 1.0 QRAT > 1.0	4.7	9.5	46	92.9*	36.5	3.4*
81	CF/TL > .1 TL/NW < 1.0 QRAT > 1.0	4.7	9.5	49	92.9*	39.5	3.2*
82	CF/TL > .2 TL/NW < 1.2 QRAT > 1.0	4.7	9.5	36	92.9*	26.5	4.3*
83	CF/TL > .2 TL/NW < 1.5 QRAT > 1.0	4.7	9.5	36	92.9*	26.5	4.3*
84	CF/TL > .15 TL/NW < 1.2 QRAT > 1.0	4.7	11.9	52	91.7*	40.1	3.5*
85	CF/TL > .15 TL/NW < 1.5 QRAT > 1.0	4.7	11.9	54	91.7*	42.1	3.4*
86	CF/TL > .1 TL/NW < 1.2 QRAT > 1.0	4.7	14.2	59	90.5*	44.8	5.3*
87	CF/TL > .1 TL/NW < 1.5 QRAT > 1.0	4.7	16.6	62	89.3	45.4	3.8*
88	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	4.7	23.8	64	85.8	40.2	4.9*

*Exceeds performance of best single ratio tests.

TABLE VIII-3

PERFORMANCE OF THREE-RATIO TESTS: PASS 2 OF 3 TO PASS

(One-Year Eligibility Requirement)
(Tests 89-120)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
89	CF/TL > .2 TL/NW < 1.0 CURRAT > 2.0	7.1	21.4	62	85.8	40.6	5.0*
90	CF/TL > .15 TL/NW < 1.0 CURRAT > 2.0	7.1	26.2	70	83.3	43.8	5.2*
91	CF/TL > .1 TL/NW < 1.0 CURRAT > 2.0	7.1	33.3	76	79.8	42.7	5.8*
92	CF/TL > .2 TL/NW < 1.2 CURRAT > 2.0	11.9	26.2	72	81.0	45.8	5.8*
93	CF/TL > .2 TL/NW < 1.5 CURRAT > 2.0	23.8	35.7	77	70.3	41.3	8.5
94	CF/TL > .15 TL/NW < 1.2 CURRAT > 2.0	11.9	30.9	74	78.6	43.1	6.4
95	CF/TL > .15 TL/NW < 1.5 CURRAT > 2.0	11.9	35.7	78	76.2	42.3	6.7
96	CF/TL > .1 TL/NW < 1.2 CURRAT > 2.0	23.8	38.0	80	69.1	42.0	8.5
97	CF/TL > .1 TL/NW < 1.5 CURRAT > 2.0	26.1	50.0	86	62.0	36.0	9.7
98	CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	26.1	52.3	93	60.8	40.7	9.3
99	CF/TL > .1 TL/NW < 1.5 CURRAT > 1.5	23.8	59.5	91	58.4	31.5	10.1

TABLE VIII-3 (Continued)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
100	CF/TL > .1 TL/NW < 2.0 CURRAT > 1.5	28.5	59.5	96	56.0	36.5	10.1
101	CF/TL > .2 TL/NW < 1.0 QRAT > 1.2	7.1	16.6	54	88.1	37.4	4.8*
102	CF/TL > .15 TL/NW < 1.0 QRAT > 1.2	7.1	19.0	59	87.0	40.0	4.8*
103	CF/TL > .1 TL/NW < 1.0 QRAT > 1.2	7.1	26.1	62	83.4	35.9	5.9
104	CF/TL > .2 TL/NW < 1.2 QRAT > 1.2	7.1	21.4	64	85.8	42.6	4.9*
105	CF/TL > .2 TL/NW < 1.5 QRAT > 1.2	14.2	28.5	70	78.6	41.5	6.7
106	CF/TL > .15 TL/NW < 1.2 QRAT > 1.2	7.1	23.8	69	84.6	45.2	4.9*
107	CF/TL > .15 TL/NW < 1.5 QRAT > 1.2	14.2	30.9	72	77.4	41.1	6.9
108	CF/TL > .1 TL/NW < 1.2 QRAT > 1.2	7.1	28.5	77	82.2	48.5*	5.1*
109	CF/TL > .1 TL/NW < 1.5 QRAT > 1.2	19.0	42.8	82	69.1	39.2	8.3
110	CF/TL > .1 TL/NW < 2.0 QRAT > 1.2	19.0	47.6	87	66.7	39.4	8.4
111	CF/TL > .2 TL/NW < 1.0 QRAT > 1.0	7.1	16.6	59	88.1	42.4	4.4

TABLE VIII-3 (Concluded)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
112	CF/TL > .15 TL/NW < 1.0 QRAT > 1.0	7.1	21.4	67	85.8	45.6	4.7*
113	CF/TL > .1 TL/NW < 1.0 QRAT > 1.0	7.1	30.9	80	81.0	49.1	5.2*
114	CF/TL > .2 TL/NW < 1.2 QRAT > 1.0	9.5	21.4	68	84.6	46.6*	4.9*
115	CF/TL > .2 TL/NW < 1.5 QRAT > 1.0	19.0	30.9	74	75.0	43.1	7.4
116	CF/TL > .15 TL/NW < 1.2 QRAT > 1.0	9.5	26.1	75	82.2	48.9*	5.2*
117	CF/TL > .15 TL/NW < 1.5 QRAT > 1.0	19.0	35.7	79	72.7	43.3	7.6
118	CF/TL > .1 TL/NW < 1.2 QRAT > 1.0	11.9	38.0	83	75.0	45.0	6.6
119	CF/TL > .1 TL/NW < 1.5 QRAT > 1.0	26.1	50.0	88	62.0	38.0	9.5
120	CF/TL > .1 TL/NW < 2.0 QRAT > 1.0	26.1	50.0	92	62.0	42.0	9.1

*Exceeds performance of best single ratio tests.

TEST VIII-4

PERFORMANCE OF MULTI-RATIO FINANCIAL TESTS INCLUDING NET FIXED ASSETS/TOTAL ASSETS

(One-Year Eligibility Requirement)
(Tests 121-151)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
	Pass All:						
121	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	2.3	4.7	43	96.5*	38.3	1.7*
122	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	2.3	4.7	53	96.5*	48.3*	1.4*
123	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	4.7	11.9	55	91.7*	43.1	3.3*
124	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	4.7	11.9	59	91.7*	47.1*	3.1*
125	NFA/TA > .25 CF/TL > .1 TL/NW < 1.5	4.7	11.9	62	91.7*	50.1*	2.9*
126	NFA/TA > .25 CF/TL > .1 TL/NW < 2.0	7.1	14.2	66	89.3	51.8*	3.6*
127	NFA/TA > .2 CF/TL > .1 TL/NW < 2.0	9.5	16.6	75	87.0	58.4*	3.8*
	Pass 2 of 3:						
128	NFA/TA > .3 CF/TL > .2 TL/NW < 1.0	7.1	11.9	62	90.5*	50.1*	3.3*
129	NFA/TA > .3 CF/TL > .2 TL/NW < 1.2	9.5	16.6	70	87.0	53.4*	4.0*
130	NFA/TA > .3 CF/TL > .2 TL/NW < 1.5	19.0	28.6	73	76.2	44.4	7.1

TABLE VIII-4 (Continued)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
131	NFA/TA > .3 CF/TL > .15 TL/NW < 1.0	7.1	14.2	71	89.3	56.8*	3.3*
132	NFA/TA > .3 CF/TL > .15 TL/NW < 1.2	9.5	19.0	76	85.8	57.0*	4.1*
133	NFA/TA > .3 CF/TL > .15 TL/NW < 1.5	19.0	30.9	80	75.0	49.1*	6.8
134	NFA/TA > .3 CF/TL > .1 TL/NW < 1.0	9.5	23.8	79	83.4	55.2*	4.6*
135	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2	11.9	30.9	83	78.6	52.1*	5.6*
136	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5	19.0	45.2	89	67.9	43.8	7.9
137	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0	21.4	54.7	92	62.0	37.3	9.1
	Pass All:						
138	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	4.7	14.2	76	90.5*	61.8*	2.8*
139	NFA/TA > .3 CF/TL > .1 CURRAT > 2.0	0	0	49	100.0*	49.0*	0*
140	NFA/TA > .3 CF/TL > .2 CURRAT > 1.5	2.3	2.3	31	97.7*	28.7	1.6*
141	NFA/TA > .2 CF/TL > .1 CURRAT > 2.0	2.3	7.1	55	95.3*	47.9*	1.9*

TABLE VIII-4 (Concluded)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
142	NFA/TA > .2 CF/TL > .2 CURRAT > 2.0	2.3	4.7	32	96.5*	27.3	2.4*
143	NFA/TA > .2 TL/NW < 1.2 QRAT > 1.0	4.7	9.5	58	92.9*	48.5*	2.6*
144	NFA/TA > .3 TL/NW < 1.0 CURRAT > 1.5	2.3	4.7	49	96.5*	44.3	1.5*
145	NFA/TA > .3 TL/NW < 1.5 CURRAT > 2.0	4.7	7.1	49	94.1*	41.9	2.6*
	Pass 2 of 3:						
146	NFA/TA > .2 CF/TL > .1 CURRAT > 1.5	21.4	64.2	95	57.2	30.8	9.9
147	NFA/TA > .3 CF/TL > .2 CURRAT > 2.0	16.6	23.8	70	79.8	46.2	6.3
148	NFA/TA > .3 CF/TL > .2 CURRAT > 1.5	21.4	30.9	80	73.9	49.1*	7.1
	Pass 3 of 4:						
149	NFA/TA > .3 CF/TL > .1 TL/NW < 2.0 CURRAT > 2.0	14.2	33.3	87	76.2	53.7*	6.0
150	NFA/TA > .3 CF/TL > .1 TL/NW < 1.5 CURRAT > 2.0	11.9	28.5	81	79.8	52.5*	5.5*
151	NFA/TA > .3 CF/TL > .1 TL/NW < 1.2 CURRAT > 2.0	7.1	19.0	77	87.0	58.0*	3.7*

*Exceeds performance of best single ratio tests.

TABLE VIII-5

PERFORMANCE OF TWO-RATIO TESTS
(Three-Year Eligibility Requirement)
(Tests 1-56)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
1	CF/TL > .2 TL/NW < 1.0	2.3	9.5	31	94.1	40.5	4.2
2	CF/TL > .2 TL/NW < 1.2	2.3	11.9	34	92.9	22.1	4.6
3	CF/TL > .2 TL/NW < 1.5	4.7	11.9	35	91.7	23.1	5.2
4	CF/TL > .2 TL/NW < 2.0	4.7	11.9	36	91.7	24.1	5.1
5	CF/TL > .15 TL/NW < 1.0	2.3	11.9	43	92.9	31.1	3.6
6	CF/TL > .15 TL/NW < 1.2	2.3	14.2	50	91.7	35.8	3.7
7	CF/TL > .15 TL/NW < 1.5	4,7	14.2	52	90.5	37.8	4.0
8	CF/TL > .15 TL/NW < 2.0	4.7	19.0	54	88.1	35.0	4.8
9	CF/TL > .1 TL/NW < 1.0	2.3	14.2	49	91.7	34.8	3.7
10	CF/TL > .1 TL/NW < 1.2	2.3	19.0	62	89.4	43.0	3.8
11	CF/TL > .1 TL/NW < 1.5	2.3	21.4	70	88.1	48.6	3.7
12	CF/TL > .1 TL/NW < 2.0	4.7	30.9	76	82.2	45.1	5.2
13	NI/TA > .04 TL/NW < 1.0	2.3	11.9	41	92.9	29.1	3.8
14	NI/TA > .04 TL/NW < 1.2	2.3	16.6	51	90.5	34.4	4.1
15	NI/TA > .04 TL/NW < 1.5	4.7	19.0	56	88.1	37.0	4.7

TABLE VIII-5 (Continued)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
16	NI/TA > .04 TL/NW < 2.0	4.7	28.5	60	83.4	31.5	6.1
17	NI/TA > .02 TL/NW < 1.0	2.3	14.2	49	91.7	34.8	3.7
18	NI/TA > .02 TL/NW < 1.2	2.3	19.0	60	89.4	41.0	3.9
19	NI/TA > .02 TL/NW < 1.5	4.7	26.1	69	84.6	42.9	4.9
20	NI/TA > .02 TL/NW < 2.0	7.1	38.0	75	77.4	37.0	6.6
21	CF/TL > .2 CURRAT > 2.0	0	4.7	25	97.7*	20.3	2.0*
22	CF/TL > .15 CURRAT > 2.0	0	9.5	37	95.3	27.5	2.8*
23	CF/TL > .1 CURRAT > 2.0	0	14.2	49	92.9	34.8	3.2*
24	CF/TL > .2 CURRAT > 1.5	2.3	7.1	34	95.3	26.9	3.0*
25	CF/TL > .15 CURRAT > 1.5	2.3	14.2	46	91.7	31.8	4.0
26	CF/TL > .1 CURRAT > 1.5	4.7	26.1	64	84.6	37.9	5.3
27	CF/TL > .2 QRAT > 1.2	0	4.7	20	97.7*	10.5	2.5*
28	CF/TL > .15 QRAT > 1.2	0	7.1	27	96.5*	15.1	2.9*
29	CF/TL > .1 QRAT > 1.2	0	11.9	30	94.1	18.1	4.3
30	CF/TL > .2 QRAT > 1.0	2.3	7.1	32	95.3	24.9	3.2*
31	CF/TL > .15 QRAT > 1.0	2.3	11.9	43	92.9	31.1	3.6

TABLE VIII-5 (Continued)

Test Number	Test Variables	M_B	M_W	A_{NB}	C	D	E_P
32	CF/TL > .1 QRAT > 1.0	4.7	23.8	52	85.8	28.2	6.1
33	TL/NW < 1.0 CURRAT > 2.0	2.3	11.9	42	92.9	30.1	3.7
34	TL/NW < 1.2 CURRAT > 2.0	7.1	19.0	50	87.0	31.0	5.8
35	TL/NW < 1.5 CURRAT > 2.0	9.5	23.8	55	83.4	31.2	6.7
36	TL/NW < 2.0 CURRAT > 2.0	11.9	30.9	56	78.6	25.1	8.4
37	TL/NW < 1.0 CURRAT > 1.5	2.3	19.0	53	89.4	34.0	4.4
38	TL/NW < 1.2 CURRAT > 1.5	7.1	26.1	66	83.4	39.9	5.5
39	TL/NW < 1.5 CURRAT > 1.5	9.5	35.7	76	77.4	40.3	6.6
40	TL/NW < 2.0 CURRAT > 1.5	16.6	50.0	80	66.7	30.0	9.2
41	TL/NW < 1.0 QRAT > 1.2	2.3	7.1	26	95.3	18.9	4.0
42	TL/NW < 1.2 QRAT > 1.2	2.3	14.2	30	91.7	15.8	6.1
43	TL/NW < 1.5 QRAT > 1.2	4.7	19.0	33	88.1	14.0	7.9
44	TL/NW < 2.0 QRAT > 1.2	4.7	21.4	33	86.9	11.6	8.7
45	TL/NW < 1.0 QRAT > 1.0	4.7	9.5	46	92.9	36.5	3.4
46	TL/NW < 1.2 QRAT > 1.0	7.1	16.6	50	88.1	33.4	5.2
47	TL/NW < 1.5 QRAT > 1.0	11.9	23.8	54	82.2	30.2	7.3

RESOURCE CONSERVATION AND RECOVERY ACT
SUBTITLE C - HAZARDOUS WASTE MANAGEMENT

Section 3004 - Standards Applicable to Owners and Operators of
Hazardous Waste Treatment, Storage, and Disposal Facilities

40 CFR Parts 264 and 265, Subpart H
Financial Requirements

BACKGROUND DOCUMENT FOR THE FINANCIAL TEST & MUNICIPAL REVENUE TEST FINANCIAL ASSURANCE FOR CLOSURE AND POST-CLOSURE CARE

APPENDIX B

COST ANALYSIS FOR A FINANCIAL TEST

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF SOLID WASTE

November 30, 1981

TABLE OF CONTENTS

Page

I. GENERAL APPROACH I-1

  A. Types of Costs Analyzed I-1

  B. Overview of the Cost Model I-5

  C. Costing Conventions I-8

II. STRUCTURE AND VARIABLES -- THE COST ESTIMATING MODEL II-1

  A. Summary Equations II-1

  B. Supporting Equations of the Model II-4

  C. Values of Variables Used in the Model II-8

III. VALUES OF MAJOR MODEL VARIABLES III-1

  A. Value for N (Number of facilities by facility type owned by firms of over $10 million in net worth that are independently audited) III-1

  B. Values for C (Closure costs) and PC (Post-closure costs) III-7

  C. Values for C_{LS} (Fees for letter of credit during facility life/facility/year) and C_{LP} (Fees for letter of credit during post-closure/facility/year) III-9

  D. Value for C_A (Private costs of auditor's special report/facility/year) III-10

  E. Values for R_{CP} (Share of closure and post-closure costs not recovered from bankruptcy proceedings) and R_I (Share of liability judgments not recovered from bankruptcy proceedings) III-13

  F. Private Costs of Trust Funds: How Costs of Closure Trust Funds Vary With the Length of the Pay-In Period III-19

TABLE OF CONTENTS (Continued)

IV. RESULTS OF THE COST MODEL FOR CLOSURE AND POST-CLOSURE REQUIREMENTS IV-1

A. Direct Public and Private Costs IV-1

B. Sensitivity Analysis IV-7

C. Analysis of the $10 Million in Net Worth Requirement IV-15

I. GENERAL APPROACH

The purpose of this section is to provide a non-technical and non-mathematical summary of the approach used in determining costs. It is divided into three sections. Section A defines the costs to be analyzed. Section B presents an overview of the structure of the cost model. Section C sets forth the costing conventions used in this Appendix.

A. Types of Costs Analyzed

Two types of costs are examined by the Agency: direct public costs and private costs.

1. Direct Public Costs

Direct public costs are defined as those costs of closure and post-closure that must be borne by someone other than the owner or operator of a hazardous waste TSDF. Thus, if the funds available from a financial mechanism at the time of need were inadequate, but funds could be recovered from the firm through legal proceedings, the Agency did not count such recovered funds as part of the direct public costs. Any costs of litigation associated with the recovery of funds from bankrupt[1] firms were not included in direct public costs. Costs that did not differ with respect to the choice of financial mechanisms were also not counted as direct public costs. Thus, costs of facility cleanup and repair, liability judgments and costs to the Agency of administering the regulation and processing reports were not included.

---

[1] In this Appendix, the terms bankruptcy and business failure are used interchangeably to connote an economic rather than a legal condition.

Within the broad category of direct public costs associated with closure and post-closure financial responsibility, the Agency considered two sources of direct public costs:

(1) Direct public costs due to failure of firms using a letter of credit. These are all costs of closure and post-closure that cannot be adequately funded from the letter of credit or from any other funds recovered from the firm.

(2) Direct public costs due to the failure of firms using a financial test. These are all costs of closure and post-closure that cannot be recovered through legal proceedings for firms that pass the financial test and later enter bankruptcy without providing other mechanisms of financial assurance.

2. Private Costs

Private costs were defined as the costs to the regulated community of obtaining financial mechanisms to serve as assurances of financial responsibility. Such costs include fees for letters of credit, fees for surety bonds, trustee fees, and costs of financial reports. Because the function of the cost analysis was to compare the costs of the financial mechanisms used to satisfy the closure and post-closure requirements, only the differential costs of mechanisms were measured. Costs that all financial mechanisms have in common, such as the costs to the owner or operator of preparing and revising cost estimates, time spent on decision-making with respect to choice of financial mechanism, and other routine management costs associated with maintaining any financial mechanism, were not included in private costs.

For the analysis of financial tests providing financial assurance for closure and post-closure care, two types of private costs were considered:

(1) The private costs of a letter of credit. This cost includes the fees for the letters of credit but does not include the fees, which were assumed to be minimal, for the accompanying standby trust funds. A letter of credit's effect on future borrowing costs is not included as a cost of a letter of credit, because it would be extremely difficult to distinguish this effect from the more general effect of having a certain future obligation (i.e., to perform closure or post-closure care) for which the letter of credit only provides a type of third-party guarantee. Borrowing costs for all owners or operators without regard to which financial assurance mechanism is provided may be affected by closure and post-closure financial assurance obligations.

The letter of credit was chosen as the instrument whose costs would be analyzed in comparison to the costs of a financial test because it is the instrument most likely to be used by firms of greater than $10 million in net worth that are independently audited, and because it will probably be the least expensive instrument. Both the letter of credit and the surety bond will be less expensive than the trust fund; the letter of credit will be more readily available, particularly to firms that can supply collateral or which have established credit, and will probably be slightly less expensive than the surety bond.

(2) The private costs of a financial test. This cost includes the annual preparation of auditors' special reports. Since only firms that

are independently audited are eligible for a financial test, the private costs of the financial test include only the preparation of the auditor's special report and not the cost of the audit itself.

One limitation of this analysis is that it assumes that firms which are not required by SEC regulations to be independently audited will not do so for the sole purpose of satisfying a financial test rather than providing one of the alternate forms of financial responsibility. It is possible, however, that a privately-held company, or any other company not required by the SEC to be independently audited, might choose to undergo annual independent audits if otherwise faced with having to set up a trust fund.

A small CPA firm estimated the following costs for full, high quality audits assuming that the firms to be audited exhibited good internal controls, bookkeeping systems, and procedures:

- For firms with sales of approximately $250,000 and one location, audits could range between $2,500 and $3,000.
- For firms with sales of approximately $500,000 and one location, audits could range between $3,000 and $6,000.
- For firms with sales of approximately $1,000,000 and one location, an audit could range between $5,000 and $8,000.
- For firms with sales of approximately $10,000,000 and one location, an audit could range between $10,000 and $20,000. At two locations, it could range between $15,000 and $25,000. At three locations, it could range between $20,000 and $30,000.

The average annual cost of a letter of credit, per facility, is approximately $745. Therefore, only firms which own an unusually large number of facilities or an unusually large facility, or which exhibit financial characteristics which would allow them to satisfy a financial test but not get a letter of credit (leaving only the trust fund option) would probably choose the option of getting an independent audit.

B. Overview of the Cost Model

In Appendix A, over 300 possible financial tests were examined with respect to their accuracy in classifying non-bankrupt firms (A_{NB}) and the number of firms per 10,000 that pass them and later enter bankruptcy without providing alternate financial assurance (E). A_{NB} represents the percentage of non-bankrupt firms that pass a given test; since the number of bankrupt firms per 10,000 firms is so small, A_{NB} effectively represents the percentage of all firms that pass a given test. This Appendix will examine the costs of the tests on the performance curves described in Appendix A using the primary sample of bankrupt and non-bankrupt firms and the most probable estimates for the number of firms per 10,000 that pass the financial tests and then go bankrupt without providing alternate financial assurance (E_P). The primary sample of bankrupt and non-bankrupt firms did not include any public utilities. Although no data are available on the share of all hazardous waste management facilities owned by public utilities, it is believed to be relatively small.

All of the tests examined in Appendix A have in common the following two requirements for firms wishing to pass the test:

(1) The firm must have a minimum net worth of $10 million; and

(2) The firm must have net worth and net working capital of at least six times the estimated closure and post-closure costs and 6 times the liability requirements. An analysis of the effects of dropping the

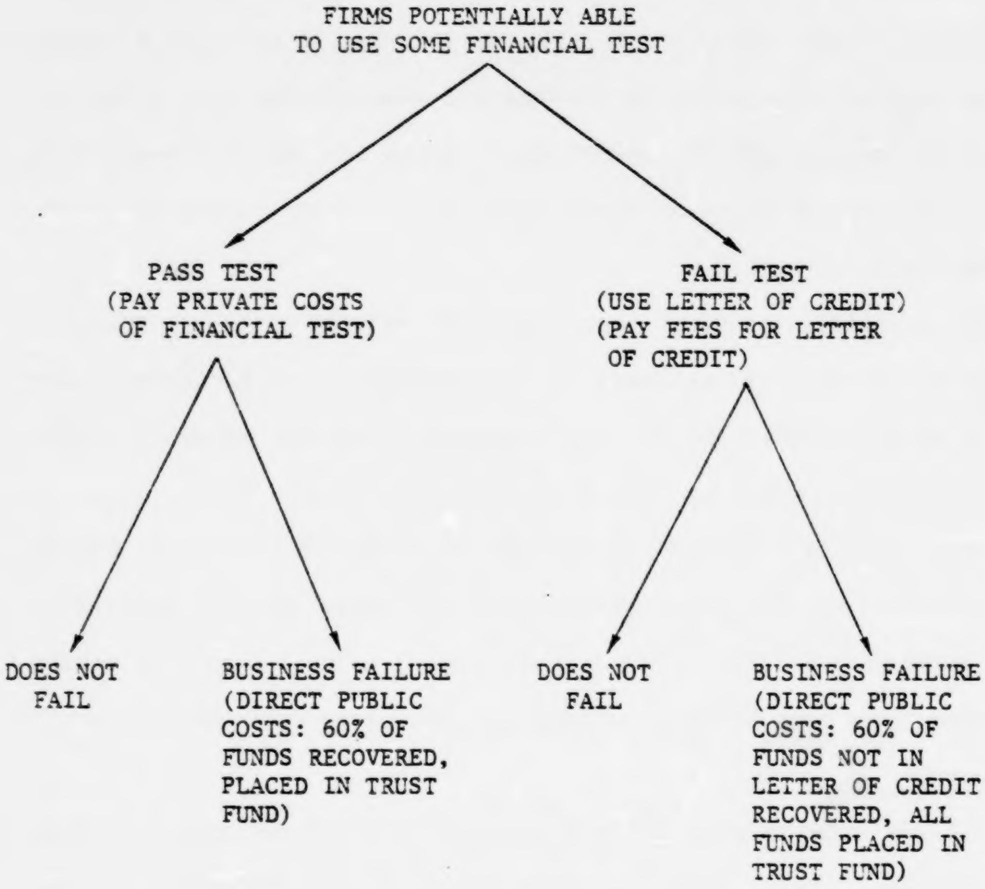
$10 million in net worth requirement from the proposed test is examined for closure and post-closure financial responsibility in Section IV.C of this Appendix. Since little or no data are available on the precise distribution of the number of facilities and their closure and post-closure costs by size of firm, the analysis is unable to take into account the effect of multiple requirements on A_{NB} and E.

The structure of the model for examining the direct public costs and private costs of financial tests for closure and post-closure financial assurance is shown in Figure I-1. The basis of the model is that a firm with $10 million in net worth and independently audited will either pass or fail any given financial test. The costs for firms with less than $10 million in net worth or for those that are not independently audited are not included. All firms that pass the test will incur the private costs of a financial test, i.e., the costs of obtaining auditors' special reports. If a firm which passes the test enters bankruptcy without establishing an alternative financial mechanism prior to bankruptcy, the direct public costs which are incurred are attributed to the use of a financial test. In determining the amount of these direct public costs the Agency assumed that 60 percent of the funds needed for closure and post-closure care would be recovered in a bankruptcy proceeding (for derivation of this recovery rate, see Section III.E.). It was further assumed that the recovered funds would be placed in a trust fund.

It is assumed that firms which fail a financial test will use a letter of credit to provide financial assurance. The private costs

FIGURE I-1

STRUCTURE OF THE COST MODEL


FIRMS POTENTIALLY ABLE TO USE SOME FINANCIAL TEST
PASS TEST (PAY PRIVATE COSTS OF FINANCIAL TEST)
FAIL TEST (USE LETTER OF CREDIT) (PAY FEES FOR LETTER OF CREDIT)
DOES NOT FAIL
BUSINESS FAILURE (DIRECT PUBLIC COSTS: 60% OF FUNDS RECOVERED, PLACED IN TRUST FUND)
DOES NOT FAIL
BUSINESS FAILURE (DIRECT PUBLIC COSTS: 60% OF FUNDS NOT IN LETTER OF CREDIT RECOVERED, ALL FUNDS PLACED IN TRUST FUND)

incurred by these firms are the fees for the letter of credit. For a firm using a letter of credit, two events may occur. First, the firm may continue to be a non-bankrupt firm. In such a case, no public costs will be incurred. Alternatively, the firm may enter bankruptcy. In that case, direct public costs will be incurred. Again, the Agency assumed that 60 percent of the closure and post-closure care costs not covered by the letter of credit could ultimately be recovered from bankruptcy, and the recovered funds would be placed in a trust fund (see Section III.E.).

For any given financial test, the total private costs are computed as the sum of the private costs of the financial test for those firms able to pass that test and the fees associated with the letter of credit for those firms unable to pass that test. The direct public costs of that test are then computed as the sum of direct public costs due to using a financial test for those firms able to pass the test that later enter bankruptcy and direct public costs due to using a letter of credit for those firms that fail a financial test and later enter bankruptcy.

C. Costing Conventions

All costs in this Appendix are presented as annual costs in real 1980 dollars. The annual costs presented are not equivalent to the total expenditures required in any given year; rather these annual costs include costs and the present value of all costs incurred for post-closure care. In deriving private costs, post-closure costs are annualized over the life of the facility. For direct public costs, the present value expenditures that will be required over the entire post-closure period are presented as annual costs in the year the firm enters bankruptcy and firm failures occurring in the post-closure period are annualized back over the life of the facility. All costs are calculated assuming a facility life of 20 years and a 30-year post-closure period.

The convention used in measuring private costs is the change in revenue necessary to leave the profits of a firm unchanged, which is the convention usually employed in EPA regulatory analysis. The most commonly used alternative convention is that of decline in profits to the firm if it cannot increase revenues. The disadvantage to this approach is that it would then require a third category of costs to be calculated -- costs to States and the Federal government due to losses in corporate profits tax.

II. STRUCTURE AND VARIABLES -- THE COST ESTIMATING MODEL

This section includes a discussion of the equations used to estimate public and private costs, the definitions of the variables employed, and the values of the variables used in the estimates. It is divided into three parts: Part A presents the summary equations for computing the costs of any given financial test, Part B presents the supporting equations used to compute the value of certain variables used in Part A, and Part C presents the values of variables employed in the equations and provides brief discussions of why these values were assumed. (Section III presents more detailed support for the values of many of the more important variables.)

A. Summary Equations for Computing Total Annualized Costs of Alternative Financial Tests for Closure and Post-Closure Financial Responsibility

Table II-1 presents the formulae used to calculate total annualized costs of direct public costs and private costs for any given financial test for firms of greater than $10 million in net worth and independently audited. Table II-2 presents the definitions of the variables used in the equations. The constant term of the equation for public costs due to failure of firms using a letter of credit ($142,000) represents the public costs if all firms considered were to use a letter of credit and go bankrupt at the failure rate for all large firms, i.e., 22 per 10,000 (F). The constant term for public costs due to failure of firms using a financial test represents the costs if all firms considered were to use a financial test and go bankrupt at the failure

TABLE II-1

FORMULAE FOR CALCULATING TOTAL ANNUALIZED COSTS OF DIRECT PUBLIC COSTS AND PRIVATE COSTS OF CLOSURE AND POST-CLOSURE FOR ALL FIRMS WITH GREATER THAN $10 MILLION IN NET WORTH AND INDEPENDENTLY AUDITED

Type of Cost	Formula	Value of Constant Term
Public Costs due to Failure of Firms using a Letter of Credit	$142{,}000 \left(\frac{F-A_{NB}E}{F}\right)$	$\sum_{1} N_i \, PU_{Li}$ = Sum of Public Costs if all facilities use a letter of Credit and fail at a rate of .0022
Public Costs due to Failure of Firms Using a Financial Test	$527{,}000 \left(\frac{A_{NB}E}{F}\right)$	$\sum_{1} N_i \, PU_{Fi}$ = Sum of Public Costs if all facilities use a Financial Test and fail at a rate of .0022
Private Costs of Using a Letter of Credit	$3{,}334{,}000 \left(1-A_{NB}\right)$	$\sum_{1} N_i \, C_{Li}$ = Sum of Private Costs if all facilities use a Letter of Credit
Private Costs of Using a Financial Test	$251{,}000 \left(A_{NB}\right)$	$\sum_{1} N_i \, C_{Fi}$ = Sum of Private Costs if all facilities use a Financial Test

Note: For definition of variables, see Table II-2.

TABLE II-2

DEFINITIONS OF VARIABLES USED IN TABLE II-1

A_{NB} = Percentage of viable firms that pass a given financial test

C_F = Annualized private costs of auditor's special report/facility/year of facility life

C_L = Annualized private costs of fees for a letter of credit/facility/year of facility life

E = Number of firms per 10,000 that pass a given financial test that will go bankrupt without prividing alternate financial assurance

F = Failure rate for all firms to which analysis is applied

i = Subscript for facility class (storage, incinerator, surface impoundment, land disposal)

N = Number of facilities owned by firms with $10 million in net worth and independently audited

PU_F = Direct public costs due to failure of firms using a financial test/facility

PU_L = Direct public costs due to failure of firms using a letter of credit/facility rate, F. The constants in the equations used to calculate the private costs are the costs if all firms were either to use a letter of credit or a financial test.

To determine the costs associated with any given financial test, these constants must be proportionately adjusted to reflect the actual numbers of firms which pass a given test but later go bankrupt without providing other financial assurance.[1]

B. Supporting Equations of the Model

1. Derivation of PU_L (Direct public costs due to failure of firms using a letter of credit/facility)

Using a letter of credit to cover closure and post-closure could incur direct public costs for the following reasons.

a. A letter of credit need only be annually adjusted for inflation during the operating life of the facility.

The amount of funds guaranteed by a letter of credit will not increase until and unless the letter of credit is adjusted. Only just after it is adjusted will it sufficiently cover a cost estimate. It is assumed that when the funds guaranteed by a letter of credit must actually be used, the letter of credit will be approximately 8 percent short of the necessary coverage (due to failures to increase it and time lags even if it is increased).

---

[1] Since all firms will either pass a financial test or fail the test and use a letter of credit under the assumptions of this model, A_{NB} represents for any given test the percentage of firms passing the test and $1-A_{NB}$ represents the percentage of firms which must use a letter of credit. E represents for any given test the number of firms per 10,000 that pass the test but will later go bankrupt without providing alternative financial assurance. Therefore, $A_{NB}E$ equals the total number of viable firms per 10,000 that pass any given test that will actually go bankrupt. The term E enters into the variables PU_{Li} and PU_{Fi} in a non-linear manner during the post-closure period. As a result, the approach used here is an approximation of true direct public costs. However, computations of the actual values showed that this approximation results in errors of less than two percent given the very low values of E.

b. A letter of credit need not be adjusted for inflation during the post-closure period.

If inflation continues during the post-closure period, a letter of credit will not sufficiently cover a post-closure cost estimate at most points in time during post-closure. Assuming a constant annual inflation rate of 8 percent and equal annual expenditures for post-closure care, the amount of funds actually required to carry out post-closure care would increase in any year in which the inflation rate (8 percent) exceeds the fraction, one over the number of years remaining in the post-closure period.

In order to entirely cover the post-closure cost estimate, the letter of credit would have to increase until the 17th year of the post-closure period, i.e.,

$$\frac{1}{30-18}\,(8.33\%) \; > \; 8\% \; > \; \frac{1}{30-17}\,(7.69\%)$$

c. The funds guaranteed by a letter of credit will be deposited into a trust fund if EPA has to direct closure or post-closure activities.

In the event that the funds guaranteed by a letter of credit for post-closure are deposited into a post-closure trust fund, it is necessary to examine the real rate of return of a trust fund. Assuming a -1.5 percent real rate of return, the real purchasing power of the trust fund will decrease by 1.5 percent a year.

d. A letter of credit may voluntarily be converted to a trust fund.

Firms which voluntarily switch from letters of credit to trust funds need only deposit that portion of the cost estimate which the trust fund would have contained if it had been established by the effective date of the regulation or before the initial receipt of hazardous waste. This would be equal to the cost estimate times the number of years since the effective date of the regulation or since the permit was granted divided by the total estimated active life of the facility or the term of the permit. Firms realizing that their letters of credit might be cancelled could voluntarily switch to trust funds thereby switching from a mechanism which guaranteed almost the entire cost estimate to one which guaranteed only a portion of it. To analyze this effect, it was assumed that the average build-up period for trust funds would be 10 years and 20 percent of all firms which would ultimately go bankrupt would convert their letters of credit to a trust fund voluntarily at some point prior to bankruptcy.[1]

The formulae accounting for all of these direct public costs incurred by letters of credit are given in Table II-3. This Table also includes definitions of the variables employed.

2. Derivation of PU_F (Direct public costs/facility due to failure of firms using a financial test)

If a firm passes the financial test near the time of actual bankruptcy, it is unlikely that there will be sufficient time for an alternative financial mechanism to be established. Consequently, all closure

---

[1] Although this assumption oversimplifies the regulation, regardless of the specific life of the facility or the term of the permit, switching from a letter of credit to a trust fund may reduce the amount of funds required to be deposited in a trust fund.

TABLE II- 3

FORMULAE FOR PU_L (DIRECT PUBLIC COSTS DUE TO FAILURE OF FIRMS USING A LETTER OF CREDIT/FACILITY)

Facility Life: Closure	$(1-v)\ R_{CP} F L_L C + v R_{CP} F \frac{r}{1-(1+r)^{-20}} \sum^{10} \frac{(10-t)/10C}{(1+r)^t}$
Facility Life: Post-Closure	$(1-v)\ R_{CP} F \frac{1-(1+r)^{-30}}{30r} \left(\sum^{30} \frac{1/30}{(1+r_t)^t} - 1 + L_L \right) PC + v R_{CP} F \frac{r}{1-(1+r)^{-20}} \sum^{10} \frac{(10-t)/10}{(1+r)^t} PC$
Post-Closure Period	$\frac{(1+r)^{-20} r}{1-(1+r)^{-20}} R_{CP} PC \sum^{10} \frac{(1-F)^t F \frac{1-(1+r)^{30-t}}{30r} \left(\left(\sum^{30-t} \left(\frac{1/30}{(1+r_t)^t} + \frac{(30-t/30) - (1+h)^t}{(1+r)^t} \right) - 1 \right) \right)}{(1+r)^t}$

C = Closure costs

F = Failure rate for all firms to which analysis is applied

h = Rate of inflation

L_L = Average loss from a letter of credit due to failure to adjust for inflation during facility life

PC = Post-closure costs

r = Real interest rate

R_{CP} = Share of closure and post-closure costs not recovered by bankruptcy proceedings

t = Time

T = Length of post-closure period

v = Rate at which firms which will later go bankrupt voluntarily shift from a letter of credit to a trust fund and post-closure costs must be collected from a bankrupt firm. However, because all funds collected for post-closure must be placed in a trust fund, further losses must be accounted for since the rate of return on this trust fund will be inadequate to maintain the required real purchasing power for post-closure care (see Section II.B.1.).

The formulae for accounting for all these potential losses and thus for deriving PU_F are given in Table II-4. This Table also includes the definitions of the variables employed.

3. Derivation of C_L (Annualized private costs of fees for a letter of credit/facility/year) and C_F (Annualized private costs of auditor's special report/facility/year

Once the costs of a letter of credit and a financial test have been determined, they must be computed over the operating life of the facility and during post-closure. During facility life, the annual costs per facility are simply the private costs given. For facilities requiring post-closure care, the present value of the cost of maintaining a letter of credit or financial test through post-closure must be computed, and then annualized over the life of the facility (which is assumed to be 20 years). Because the auditor's fee for a special report supporting the financial test will increase with inflation while the fee for a letter of credit will not, different formulae for determining the present value of costs are necessary. These formulae are presented in Table II-5. This Table also includes the definitions of the variables employed.

C. Values of Variables Used in the Model

Tables II-6 and II-7 present the values of variables used in estimating the costs discussed in this model. Table II-6 describes the

TABLE II-4

FORMULAE FOR PU_F (DIRECT PUBLIC COSTS DUE TO FAILURE OF FIRMS USING A FINANCIAL TEST/FACILITY)

Facility Life: Closure	$R_{CP}FC$
Facility Life: Post-Closure	$R_{CP}F \ \frac{1-(1+r)^{-30}}{30r} \left(\sum^{30} \frac{1/30}{(1+r_T)^t} \right) PC$
Post-Closure Period	$\frac{(1+r)^{-20} r}{1-(1+r)^{-20}} \ R_{CP} PC \sum^{30} \frac{(1-F)^t \ F \ \frac{1-(1+r)^{30-t}}{30r} \ \sum^{30} \frac{1/30}{(1+r_T)^t}}{(1+r)^t}$

C = Closure costs

F = Failure rate for all firms to which analysis is applied

PC = Post-closure costs

r = Real interest rate

R_{CP} = Share of closure and post-closure costs not recovered from bankruptcy proceedings

t = Time

T = Length of post-closure period

TABLE II-5

FORMULAE FOR DERIVING PER FACILITY PRIVATE COSTS OF A LETTER OF CREDIT AND A FINANCIAL TEST

Financial Assurance Mechanism	Coverage Period	
	Facility-Life	Post-Closure
Letter of Credit	C_{LS}	$\frac{(1+r)^{-20} r}{1-(1+r)^{-20}} \; \frac{1-(1+r+h)^{-30}}{(r+h)} \; C_{LP}$
Financial Test	C_A	$\frac{(1+r)^{-20} r}{1-(1+r)^{-20}} \; \frac{1-(1+r)^{-30}}{r} \; C_A$

C_A = Private costs of auditor's special report/facility/year

C_{LP} = Fees for letters of credit during post-closure/facility/year

C_{LS} = Fees for letters of credit during facility life/facility/year

h = Rate of inflation

r = Real interest rate

TABLE II-6

VALUES FOR VARIABLES THAT DO NOT VARY BY FACILITY TYPE

*Private costs (thousands of dollars) of auditor's special report/facility/year (C_A)	= .075
Failure rate for all firms to which analysis is applied (F)	= .0022
Rate of inflation (h)	= .08
Average loss from a letter of credit due to failure to adjust for inflation during facility life (L_L)	= .08
Real interest rate (r)	= .03
Real rate of return on trust (r_t)	= -.015
*Share of closure and post-closure costs not recovered from bankruptcy proceedings (R_{CP})	= .4
Rate at which firms which will later go bankrupt voluntarily shift from a letter of credit to a trust fund (v)	= .2

*More detailed discussions on the values of these variables may be found in Section III of this Appendix.

TABLE II-7

ASSUMPTIONS WHICH VARY ACCORDING TO TYPE OF FACILITY
(costs measured in thousands of 1980 dollars per year)

Assumptions	Facility Type			
	Storage	Incinerators	Surface Impoundments	Land Disposal
1) Number of facilities (N) (17% of total facilities)*	1.292	.153	.680	.425
2) Closure costs (C) (per facility)*	15	50	60	100
3) Post-closure costs (PC) (per facility) (equal to 30 times the annual post-closure costs)*	0	0	300	500
4) Fees for letter of credit (during facility life/facility/year) (.5% of face value of closure costs)*	.075	.25	1.8	3
5) Fees for letter of credit during post-closure period/facility/year (C_{LP}) (.5% of face value of post-closure costs)*	0	0	1.5	[illegible].5

*A detailed discussion on the values of these variables may be found in Section III of this Appendix.

Reproduced from best available copy.

variables that do not vary by type of hazardous waste facility considered, and Table II-7 shows the variables that do change according to the type of facility. (More detailed discussions on the values of the variables marked by an asterisk may be found in Section III of this Appendix).

A real interest rate (long-term interest rate discounted for inflation) of 3 percent is used throughout the model's calculations. This real interest rate is used to discount public and private costs that occur during the post-closure period, and to annualize these costs over the operating life of the facility. The long-term inflation rate is assumed to be 8 percent: this 8 percent figure is also assumed to be the rate of loss on letters of credit resulting from inflation-related coverage inadequacies.

The real rate of return on trust funds is assumed to be -1.5 percent per year. The effects of taxes and trustee fees result in a rate of return less than the zero percent implicitly assumed in the regulation establishing the required size of the trust fund. This negative rate of return has two important effects: (1) the amount of funds in a post-closure trust fund would not be sufficient for 30 years of post-closure care, and (2) regular inflation adjustments would have to be made to the trust fund.

It is assumed that 60 percent of the funds needed for closure and post-closure can be recovered from bankrupt firms. This means that 40 percent will not be recovered and thus be left as direct costs to the public. This factor is applied to bankrupt firms that used either a financial test or a letter of credit as a financial assurance mechanism. The basis for this estimate is given in Section III.E.

A failure rate for the kinds of large firms that could pass the ability-to-pay portion of the financial test is assumed to be 22 per 10,000 (or 17 failures per year among the 7,500 firms considered in this analysis). The total number of bankruptcies among this group of firms is assumed to be constant, regardless of the financial test used: thus, if the failure rate for a given financial test falls below 22 per 10,000, the failure rate for firms which fail the financial test will become higher to maintain the same overall result.

The rate at which firms that will later go bankrupt voluntarily switch from letters of credit to trust funds to provide financial assurance is assumed to be 0.2 (i.e., 2 out of 10 firms).

Based on interviews with auditors, the costs of a special report (required annually for firms applying for the financial test) is estimated at $300 per year. Assuming that the average firm has four facilities, as discussed in Section III.A., the per-facility annual cost is $75.

It has been conservatively assumed that firms large enough to meet the Ability to Pay Test outlined in Section III.A. own 50 percent of all hazardous waste facilities. Of the 50 percent of all facilities owned by firms of greater than $10 million in net worth, 34 percent are independently audited. Thus, the total population of facilities evaluated in this cost analysis is assumed to be 2,550, composed of 1,292 storage facilities, 153 incinerators, 680 surface impoundments, and 425 landfills.

Costs for each type of facility are developed separately for the following variables:

1. Closure and post-closure costs: The cost estimates are based on well-run, small facilities that will not need remedial measures or other special kinds of activities during closure or post-closure. Given the scanty data both on the average size of facilities and costs of closure and post-closure, these estimates are not definitive.

2. Cost of letter of credit: The cost of a letter of credit is estimated to be .5 percent of the face value of the costs to be covered (i.e., the costs of closure and post-closure). This estimate was derived from interviews with banks currently providing letters of credit.

III. VALUES OF MAJOR MODEL VARIABLES

A. Value for N (Number of facilities by facility type owned by firms of over $10 million in net worth that are independently audited)

The total number of TSDFs is based upon the number of permit applications. The division of this total into facility types is based upon the distribution of total facilities by type estimated by EPA prior to the receipt of permit applications:

Storage	7,600
Surface Impoundments	4,000
Land Disposal	2,500
Incinerators	900
Total	15,000

No data were provided for treatment facilities other than incinerators.

It is assumed that 50 percent of all facilities are owned by firms with greater than $10 million in net worth. This assumption is based on the following data:

(1) If hazardous waste production in an industry is roughly proportional to revenues (a common assumption in many studies), the figures below imply that, with the exception of electroplating, the vast bulk of hazardous waste is produced and disposed of by large firms. Putnam, Hayes and Bartlett (Hazardous Waste Generation and Disposal Estimates 1980) lists the following industries as the four largest sources of hazardous waste:

SIC	28	Chemicals and Allied Products	62%
SIC	29	Petroleum and Coal Products	5%
SIC	33	Primary Metals	10%
SIC	34	Fabricated Metals (including job shop plating)	5%
		Total	82%

For similar industries, L. Troy, in The Almanac of Business and Industrial Financial Ratios (1979), lists the following percentages of revenues in these industries from firms of over $25 million in assets:[1]

Industrial Chemicals, Plastics and Synthetics	90%+
Petroleum Refining	95%+
Primary Metals	80%+
Coating, Engraving and Allied Services	0

(2) A correlation exists between the size of the firm and the number of plants that it owns. To determine the relationship between the size of a firm and the number of plants it might own, a sample list of 46 chemical companies and their plant holdings was compiled from the 1978 Directory of Chemical Producers and summarized in Table III-1. Based on this sample, the average number of plants per firm is 9.34 and the percentage of all plants owned by firms that own at least 10 plants is 84.6 percent.

---

[1] For the kinds of industries being considered here, the ratio of total liabilities to net worth is on the average 1 to 1. Since the sum of total liabilities and net worth is equal to total assets, it is assumed that these firms with over $25 million in assets also have over $10 million in net worth.

TABLE III-1

PLANT HOLDINGS FOR THE SAMPLE OF 46 FIRMS

	Number of Firms	Number of Plants Owned
	26	1
	12	2-20
	3	10-20
	0	20-45
	5	45-80
TOTAL	46	430[1]

The share of all facilities owned by firms with greater than $10 million in net worth is conservatively estimated as only 50 percent (compared to the 80 to 90 percent implied by chemical industry data) to adjust for industries such as electroplating which produce a large share of hazardous wastes but are made up of smaller firms.

The second step in deriving N is to determine what percentage of the facilities owned by firms of over $10 million in net worth are also firms which are independently audited. A firm which is not already independently audited for other regulatory reasons will normally find the costs of an audit high enough to make the use of a financial test more expensive than other financial mechanisms. In general, a firm will not be independently audited unless it is required to file a Form 10K under SEC rules. According to Sections 12B and 12G of the Securities Exchange Act of 1934, 10K Reports must be filed annually by:

---

[1] Although the number of plants is given with a range, the actual total number of plants is 430.

(1) Any firm traded on a national stock exchange (e.g., NYSE, AMEX, Pacific Exchange): and

(2) Any firm with $1 million in assets and 500 shareholders.

Ideally, to determine N, the percentage of firms filing 10K's by size should be applied to the distribution of facilities by size of firms. As noted above, data on the distribution of facility ownership by firm size are not available. In addition, the data available for determining the percentage of firms in a given size class which file 10K's also have serious limitations. An estimate of 34 percent used in this Appendix was derived from the following data:

(1) Distribution of firms filing 10K's in 1980 by asset size: The SEC data base on the distribution of firms filing 10K's by asset size omits 2,400 firms (29 percent of all firms filing 10K's) which are traded as over-the-counter stocks. All New York and American Stock Exchange firms are included, as well as an estimated 3,600 firms which are traded over the counter and in minor exchanges.

(2) Distribution of corporations by asset size for all active corporations in 1975: These data are provided by the Internal Revenue Service based on the number of corporations that pay corporate income taxes. Unfortunately, 1975 is the most recent year of available data. In addition, because this data base lists all firms which pay taxes, it will include the subsidiaries of each parent corporation, thus overestimating the total number of corporations.

Tables III-2a and III-2b show the estimated percentages of firms filing 10K's by asset size using the two data bases described above. Twenty-five million dollars in assets are approximately equal to $10 million in net worth. The number of firms filing 10K's in Table III-2a are based on the SEC data described above. Since the SEC data omit 2,400 firms, Table III-2b presents revised estimates of the total number of firms filing 10K's by size including these 2,400 firms by assuming that all of them have less than $50 million in assets and have the same distribution within the size ranges as the firms already included in the data base.

For purposes of the cost estimates, the value derived in Table III-2b for the percentage of total corporations with greater than $10 million in net worth that file 10K's is used as the percentage of facilities owned by firms that are independently audited (i.e., 34 percent). In the analysis of the effect of the $10 million in net worth requirement in Section IV.C., 2.7 percent of firms with less than $10 million in net worth are assumed to be independently audited. These assumptions may underestimate the true percentages to the extent that using 1975 data on active corporations underestimates the actual number of active corporations by size class. However, these assumptions may be overestimates to the extent that the majority of facilities are owned by the largest firms in each size class and many subsidiaries whose parent firms file 10K's are included in the number of active corporations. Table III-3 shows a more complete distributional breakdown of the data presented in Table III-2a. As shown in this Table, the percentage of

TABLE III-2

ESTIMATED PERCENTAGE OF FIRMS FILING 10K'S BY ASSET SIZE

TABLE III-2a

ESTIMATED PERCENTAGE OF FIRMS FILING 10K'S BY ASSET SIZE WITHOUT ADJUSTMENT FOR MISSING DATA

Total Assets (Million Dollars)	Number of 10K's Filed[1]	Total Number of Active Corporations[2]	Percentage of Total Corporations That File 10K's
Less than 1	271	1,882,347	-
1-25	1,833	128,639	1.4
25+	3,791	12,661	30

TABLE III-2b

ESTIMATED PERCENTAGE OF FIRMS FILING 10K'S BY ASSET SIZE WITH ADJUSTMENT FOR MISSING DATA

Total Assets (Million Dollars)	Revised Number of 10K's Filed[3]	Total Number of Active Corporations[2]	Revised Percentage of Total Corporations That File 10K's
Less than 1	509	1,882,347	-
1-25	3,439	128,639	2.7
25+	4,349	12,661	34

[1] Source: Disclosure Inc.

[2] Source: U.S. Internal Revenue Service, Statistics of Income, Corporation Income Tax Returns, 1975.

[3] The 2400 firms missing from the Disclosure Inc. data have been included assuming they all have less than $50 million in assets and have the same distribution within the size ranges as listed in the SEC data.

TABLE III-3

DETAILED DISTRIBUTION OF ESTIMATED PERCENTAGE OF FIRMS FILING 10K'S BY ASSET SIZE

Total Assets (Million Dollars)	Number of 10K's Filed[1]	Total Number of Active Corporations[2]	Percentage of Total Corporations That File 10K's
Less than 1	271	1,882,347	-
1-5	667	101,333	.7
5-10	450	15,091	3.0
10-25	716	12,215	5.9
25-50	634	5,567	11.4
50-100	690	3,068	22.5
100-250*	767	2,144	35.3
250+	1,700	1,882	90.3

[1] Source: Disclosure Inc.

[2] Source: U.S. Internal Revenue Service, Statistics of Income, Corporation Income Tax Returns, 1975.

[3] The original data source sorted firms filing 10K's in the following categories: $100-200 million, $200-300 million and $300 million and up. To make the categories consistent with the data on the number of active corporations, 50 percent of the firms with assets between $200 and $300 million were included in the $100-250 million category and 50 percent were included in the $250+ million category.

firms filing 10K's greatly increases as the size of firms increases. Therefore, if a majority of facilities are owned by firms with greater than $250 million in total assets, the estimate of 34 percent as the percentage of firms that are independently audited would be a gross underestimate.

Table III-4 shows the resulting values of N for firms with greater than $10 million in net worth which are independently audited. These numbers are derived as 34 percent of the number of facilities estimated to be owned by firms with greater than $10 million in net worth (i.e., 50 percent of all facilities) as discussed above.

TABLE III-4

NUMBER OF FACILITIES BY TYPE OWNED BY FIRMS OF OVER
$10 MILLION IN NET WORTH AND INDEPENDENTLY AUDITED

Storage	1,292
Surface Impoundments	680
Land Disposal	425
Incinerators	153
Total	2,550

B. Values for C (Closure Costs) and PC (Post-Closure Costs)

Table III-5 provides EPA's best estimates and appropriate ranges for costs of closure and post-closure for four types of hazardous waste facilities. These estimates are uncertain because the costs are, to a great extent, dependent upon the size of the facility, and to date, no

TABLE III-5

AVERAGE CLOSURE AND POST-CLOSURE COST ESTIMATES BY FACILITY CLASS

(in thousands of 1980 dollars)

Average Closure Cost Estimates

	Low	Best Estimate	High
Storage	7	15	22
Surface Impoundments	30	60	120
Land Disposal	50	100	150
Incinerators	25	50	75

Average Post-Closure Cost Estimates[1]

	Low	Best Estimate	High
Storage	0	0	0
Surface Impoundments	150	300	600
Land Disposal	250	500	1,500
Incinerators	0	0	0

[1] Cost estimates are equal to 30 times the annual post-closure costs.

SOURCE: Derivation from IR&T, 1980b.

data exist on the average size of TSDFs. The estimates shown here were derived from sample cost estimates of closure and post-closure provided in the draft guidance manual for complying with Subparts G and H of these regulations. To determine the costs of closure and post-closure for the average-size facility, the sample estimates in the guidance manual were reduced 50 to 80 percent to account for the fact that the sample estimates were based on large facilities, and the costs per unit disposed were greater than average in order to ensure that all necessary activities could be carried out for the cost indicated.

C. Values for C_{LS} (Fees for letter of credit during facility life/facility/year) and C_{LP} (Fees for letter of credit during post-closure/facility/year)

The per-facility costs of a letter of credit are a function of the fees associated with a letter of credit and the costs of closure and/or post-closure. The annual fee of a letter of credit is estimated to be .5 percent of its face value (i.e., the costs of closure and/or post-closure) with a range of .25 to 2 percent of the face value of the letter of credit. Bank representatives and other sources[1] contacted by EPA provided estimates of fees for standby letters of credit of between .5 and 2 percent of the value of the letter of credit. A low estimate of .25 percent of the face value of the letter of credit is possible given the possibility that market pressure by large customers could result in lower fees than banks were willing to discuss publicly. Letters of credit given in return for specific business commitments

---

[1] e.g., see Paul R. Verkuil, "Bank Solvency and Guarantee Letters of Credit," Stanford Law Review, Volume 25, May 1973, p. 721, footnote 29.

(e.g., commitment to purchase bank certificates of deposit beyond what would normally be held) would also probably be less expensive than the estimated .5 percent fee. The fact that banks generally do charge a fee for standby letters of credit is suggested by the extremely large share of all letters of credit outstanding issued by CitiBank, which has aggressively pursued letters of credit as a major line of business. Table III-6 provides estimates of the annual cost of a letter of credit by type of facility for both closure and post-closure and for only post-closure.

D. Value for C_A (Private costs of auditor's special report/facility/year)

The per-facility costs of a financial test are a function of the fees of the auditor's special report and the number of facilities owned per firm. EPA's best estimate of the auditor's fee is $300, with a range of $150 to $500. An independent auditor confirmed that the average fee for an auditor's special report describing the financial position of a firm for which an audit has already been performed ranges between $150-400. It is extremely unusual for auditors to be held liable for their opinions except in cases of fraud or negligence. However, to account for fears of nuisance suits in connection with hazardous waste, the fee range is estimated as $150-500.

It is assumed that, on the average, each firm owns four TSDFs. As discussed in Section III.A., most hazardous waste is probably produced by large firms. It was also noted that for a sample of chemical firms, the average number of plants owned was 9.34. However, since all firms may not have hazardous waste at all plants and many single-plant firms

TABLE III - 6

ADMINISTRATIVE COSTS OF LETTERS OF CREDIT TO PRIVATE SECTOR

(in thousands of 1980 dollars per year)

TYPE OF FACILITY	BEST ESTIMATE			
	Per Facility		Total Facilities	
	Closure & Post-Closure	Post-Closure Only	Closure & Post-Closure	Post-Closure Only
Storage	.075	N/A	285	N/A
Surface Impoundments	1.8	1.5	3,600	3,000
Land Disposal	3.0	2.5	3,750	3,125
Incinerators	.25	N/A	112	N/A
Total of above	N/A	N/A	7,748	6,125

will not qualify for a financial test, an average of four facilities per firm is assumed.

Assuming four facilities per firm and a $300 fee for an auditor's special report, the value for C_A (the private costs of an auditor's special report per facility per year) is $75.

E. Values for R_{CP} (Share of closure and post-closure costs not recovered from bankruptcy proceedings)

The Agency has conducted a study of the legal steps involved in the two major bankruptcy procedures -- liquidation and reorganization -- likely to be undertaken by an owner or operator of a hazardous waste TSDF, and of the main legal issues that could arise in such proceedings. The following section, based on that material, and on assumptions derived from it, generates estimates of the rate of recovery likely for EPA claims in bankruptcy proceedings and an estimate of the approximate length of time such recovery might take. Figure III-1 presents an overview of the assumptions used.

1. Value for R_{CP}

The following assumptions were used to estimate the share of closure and post-closure costs not recovered from bankruptcy proceedings (R_{CP}):

(1) The Agency concluded that the clear emphasis in the new Bankruptcy Act is toward reorganization if it is at all possible, particularly for firms with extensive assets or potentially profitable business activities. Reorganization is frequently combined with a sale of the firm, or profitable portions of the firm, to another corporation. Because of the probable size and activities of firms able to pass the

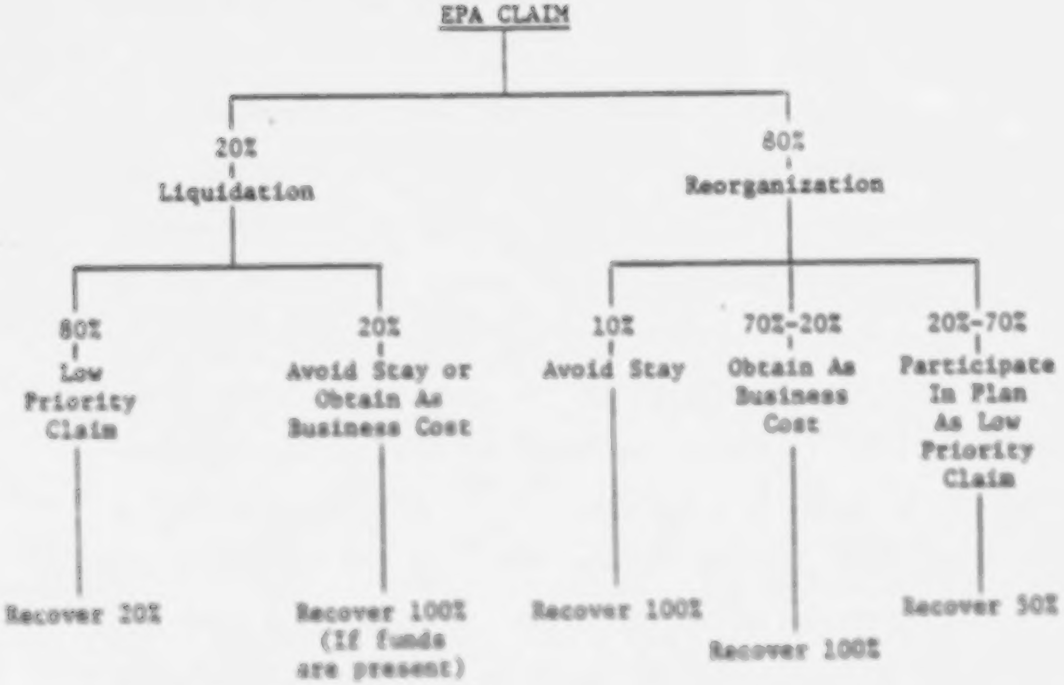

EPA CLAIM
20%
Liquidation
80%
Reorganization
80%
Low Priority Claim
20%
Avoid Stay or Obtain As Business Cost
10%
Avoid Stay
70%-20%
Obtain As Business Cost
20%-70%
Participate In Plan As Low Priority Claim
Recover 20%
Recover 100% (If funds are present)
Recover 100%
Recover 100%
Recover 50%

FIGURE III-1

OVERVIEW OF ASSUMPTIONS USED
IN RECOVERY OF CLAIMS

financial test, and the potential market for their facilities, the Agency assumed that 80 percent will reorganize and only 20 percent will liquidate.

(2) An automatic stay of almost all legal actions against a debtor is ordinarily effective upon the filing of a bankruptcy petition. Such a stay could prevent collection efforts against an owner or operator outside the bankruptcy proceeding. The Agency investigated ways in which it could avoid the automatic stay and obtain immediate access to funds for closure or post-closure care. In addition, the Agency investigated the question of whether the costs of financial responsibility would qualify as operating costs incurred in the ordinary course of business which could be paid without resort to the procedures and priorities of liquidation or reorganization. The Agency estimated that in those cases in which firms are forced to liquidate, the automatic stay will be avoided or recovery of the EPA claim will come as a cost of continuing the business in operation in only about 20 percent of the cases. Although ordinarily the estate of the debtor will not be able to satisfy claims entirely, such recoveries by the EPA will be based, when they occur, on injunctions issued to alleviate severe environmental dangers. In those situations, it was estimated that EPA will recover 100 percent of its claim. In the balance (80 percent) of the liquidation cases, the EPA claim will probably be treated as a low-priority unsecured claim of a general creditor. The estimated recovery rate on such claims was $.20 per $1.00.

Thus, recovery in liquidation will occur at a combined rate of approximately .36.

(1.0 x .20) + (.20 x .80) = .36

(3) In reorganization cases, it is expected that the automatic stay will be avoided and EPA will recover 100 percent of its claim before distribution in about 10 percent of the cases. Once again, such recoveries will be based on injunctive relief issued to alleviate severe environmental dangers.

In reorganization, however, because the ultimate goal of the process is to provide the debtor with an opportunity to continue in business, there is a strong possibility that in certain circumstances the EPA claim will be treated as a cost of maintaining the business. If the EPA claim is treated as an equivalent to an insurance premium, for example, the Agency should obtain 100 percent of the funds it requires. An uncertain variable is the frequency that the hazardous waste portion of the business will be integral to the continued operation of the business as a whole. In general, payment of the expenses of business operations in reorganization cases depends on: (a) whether the payments are critical to the continued operation of the business, (b) whether the risk that the payments are intended to alleviate is imminent, and (c) whether the payments would drastically reduce the estate of the debtor. If such payments would severely reduce their recovery, creditors might force a shift to liquidation. Thus, it has been estimated that payment of the EPA claim as expenses of the continued operation of the business could occur in from 20 percent to 70 percent of the cases.

If such claims are not paid as costs of continuing the business, they will be included in the reorganization plan. Thus, the Agency can expect to participate in such plans in from 20 percent to 70 percent of the reorganization cases. A review of several of such plans indicates that recovery by creditors occurs at a rate of approximately 50 percent.

Thus, recovery in reorganization proceedings will be expected to occur in a range of .65 to .90, as shown below.

$$(1 \times .10) + (1 \times .20) + (.70 \times .50) = .65$$

$$(1 \times .10) + (1 \times .70) + (.20 \times .50) = .90$$

(4) Adopting the lower estimate of the rate of recovery in reorganization cases, weighting it by the frequency of such cases, and adding to it the estimated rate of recovery in liquidation cases weighted by their frequency, the estimated general rate of recovery in bankruptcy equals approximately .60, as shown below.

$$(.36 \times .20) + (.65 \times .80) = .59$$

Therefore, assuming a general rate of recovery of approximately .6, the value for R_{CP} (the share of closure and post-closure costs not recovered from bankruptcy proceedings) is equal to .4.

2. Estimated Elapsed Time of a Bankruptcy Proceeding

The Bankruptcy Act does not include limits on the length of time a proceeding can take. There are, however, limits on certain aspects of the proceeding, either explicit or implicit.

In both liquidation and reorganization, for example, a creditor can obtain a decision on whether or not an automatic stay will be lifted within approximately 60 days. A court would probably also determine whether certain payments could be made as costs of the continued operation of the business within a relatively short time.

If the debtor begins a reorganization proceeding with a plan already worked out, confirmation of the plan could also take place within about 60 days. If the debtor desires to delay, however, and the creditors do not force prompt action, the debtor will have at least 180 days to develop a plan and obtain confirmation. If the debtor's plan is not accepted, the creditors are entitled to an indefinite time to work out their own plan and obtain confirmation of it, but they will probably have a strong tendency toward relatively swift action.

Liquidation proceedings frequently require more time than reorganizations, but the major variable is not so much the type of proceeding as the degree of its complication. An average of about two years may be needed to complete relatively uncomplicated business bankruptcies. Other complicated and more long-lasting cases, such as Penn Central, however, are well known.

F. Private Costs of Trust Funds: How Costs of Closure Trust Funds Vary with the Length of the Pay-In Period

To analyze the sensitivity of the results to the assumptions of the cost estimates on the model, it is necessary to determine how the costs of trust funds used by firms that fail a given test and cannot get a letter of credit will affect the costs of using a financial test. Private costs of a trust fund were computed based on the following assumptions.

1. Assumptions of the Model

The following assumptions were used with respect to the tax treatment of the trust fund.

(1) The trust fund earns a zero real rate of return.

(2) The trust fund is a grantor trust. This means that taxes on the income of trust are paid by the grantor at his marginal income tax rate.

(3) Contributions to the trust fund are not tax deductible.

(4) The firm has revenues against which to deduct business expenditures at all times.

(5) Closure costs are a tax deductible operating expense.

2. The Model

Definitions of all variables are given in Table III-7. The measure of costs used here will be the revenue recovery method, i.e., costs are the revenues necessary to restore profits to their original level. The profits of the firm in the absence of a trust fund are given by:

$$(1) \quad \pi = \sum^{T} (1 - x) \frac{R - O}{(1 + r)^t} - (1 - x)\, C\, (1 + r)^{-T}$$

With a trust fund the profits become:

$$(2) \quad \pi = \sum^{T} (1 - x) \frac{R - O}{(1 + r)^t} - \sum^{N} \frac{C/N\, (1 + i)^t}{(1 + r)^t\, (1 + i)^t}$$

$$- \sum^{N} \frac{xit\, C/N\, (1 + i)^t}{(1 + r)^t\, (1 + i)^t} - \sum^{T} \frac{xi\, C\, (1 + i)^t}{(1 + r)^t\, (1 + i)^t}$$

$$+ C\, (1 + r)^{-T} - (1 - x)\, C\, (1 + r)^{-T}$$

TABLE III- 7

DEFINITIONS AND VALUES OF SYMBOLS
(ALL DOLLAR VALUES IN REAL DOLLARS OF YEAR ZERO)

C - Closure Costs

N - Length of pay-in period to the trust fund (1-10 yrs., 15 yrs., 20 yrs.)

O - All costs other than closure

R - Revenues

T - Active life of the site (10,20, or 30 yrs.)

i - Rate of inflation (.08 per year)

r - Real after tax rate of return (.02, .03, or .04)

x - Marginal corporate profits tax rate (.5)

π - Present value after tax of corporate profits

P_r^T or P_r^N - Present value operator for interest rate r and period T or N.

$$P_r^T = \frac{1 - (1 + r)^{-T}}{r}$$

The first term and last terms are as above. The second term represents the costs of payments to the trust fund. The third term is the cost of taxes on the income of the trust fund during the pay-in period. The fourth term is the cost of taxes on the income of the trust fund once pay-in is completed. The fifth term is the payment from the trust fund for the purposes of closure.

To apply the revenue recovery measure of costs, we must determine the ΔR that sets profits with the trust fund (π (w)) equal to profits without (π (wo)), i.e.,

$$(3) \quad \pi_{(wo)} = \pi_{(w)} + \sum^{T} \frac{(1 - x)\ \Delta R}{(1 + r)^{t}}$$

Substituting appropriate values from equations (1) and (2) and solving for R gives:

$$(4) \quad \sum^{T} \frac{\Delta R}{(1 + r)^{t}} = \frac{1}{(1 - x)} \left[\sum^{N} \frac{C/N\ (1 + i)^{t}}{(1 + r)^{t}\ (1 + i)^{t}} + \sum^{N} \frac{xit\ C/N\ (1 + i)^{t}}{(1 + r)^{t}\ (1 + i)^{t}} + \sum_{N+1}^{T} \frac{xi\ C\ (1 + i)^{t}}{(1 + r)^{t}\ (1 + i)^{t}} - C\ (1 + r)^{-T} \right]$$

Solving or approximating for the summations then gives:

$$P_{r}^{T}\ (\Delta R) = \frac{C}{(1 - x)}\ (P_{r}^{N}\ (1/N) + P_{r}^{T}\ (xi) - \frac{xi}{N}\ \frac{N + 1}{2}\ P_{r}^{N} - (1 + r)^{-T}$$

Note that the second two terms provide an approximation to the true summation of the taxes paid. However, for the low interest rates involved here, this approximation is reasonably accurate.

In order to produce a dimensionless meaasure not dependent on closure costs, Tables III-8 through III-13 present values for various r, N, and T of

$$100 \times \frac{\sum^{T} \frac{\Delta R}{(1 + r)^{t}}}{C}$$

which may be termed the present net worth of real costs to the firm as a percentage of the closure cost estimate.

If this measure were calculated for post-closure, it would be significantly higher but would change in the same way with changes in the pay-in period, interest rate, and life of the facility. The formula would be:

$$100 \times \frac{\sum^{T} \frac{\Delta R}{(1 + r)^{t}}}{PC} = \frac{100}{1 - x} \left[P_{r}^{N} (1/N) + P_{r}^{T} (xi) - \frac{xi}{N} \quad \frac{N + 1}{2} \quad P_{r}^{N} \right.$$

$$\left. - (1 + r)^{-T} P_{r}^{30} \quad (1/30) \right]$$

where PC is the post-closure cost estimate for 30 years of post-closure care.

TABLE III- 8

PRESENT VALUE OF REAL COSTS OF TRUST FUND AS A PERCENTAGE OF CLOSURE COST ESTIMATE (10 YEAR SITE LIFE (T), 0% INFLATION)

r=interest rate / N=pay in period	2%	3%	4%
1	32.008	45.3556	57.1943
2	30.0858	42.528	53.4961
3	28.1886	39.7552	49.8927
4	26.3161	37.036	46.3814
5	24.468	34.3693	42.9595
6	22.6439	31.7541	39.6245
7	20.8436	29.1891	36.3739
8	19.0667	26.6733	33.2053
9	17.3127	24.2057	30.1163
10	15.5814	21.7851	27.1047

TABLE III-9

PRESENT VALUE OF REAL COSTS OF TRUST FUND AS A PERCENTAGE OF CLOSURE COST ESTIMATE (10 YEAR SITE LIFE (T), 8% INFLATION)

r=interest rate / N=pay in period	2%	3%	4%
1	96.0254	105.83	114.389
2	90.297	99.2887	107.067
3	84.6684	92.9108	99.9793
4	79.138	86.692	93.119
5	73.704	80.6282	86.4779
6	68.3645	74.7155	80.0484
7	63.1179	68.9494	73.8231
8	57.9626	63.3263	67.7951
9	52.8967	57.8424	61.9576
10	47.9186	52.4938	56.3038

TABLE III- 10

PRESENT VALUE OF REAL COSTS OF TRUST FUND AS A PERCENTAGE OF CLOSURE COST ESTIMATE (20 YEAR SITE LIFE (T), 0% INFLATION)

r=interest rate / N=pay in period	2%	3%	4%
1	61.4834	83.4392	101.03
2	59.5612	80.6116	97.3315
3	57.6639	77.8388	93.7281
4	55.7915	75.1196	90.2168
5	53.9434	72.4529	86.7949
6	52.1193	69.8377	83.4599
7	50.3189	67.2728	80.2094
8	48.542	64.757	77.0408
9	46.7881	62.2893	73.9517
10	45.0567	59.8687	70.9401
15	36.7286	48.4371	56.9674
20	28.9195	38.0394	44.6256

TABLE III-11

PRESENT VALUE OF REAL COSTS OF TRUST FUND AS A PERCENTAGE OF CLOSURE COST ESTIMATE (20 YEAR SITE LIFE (T), 8% INFLATION)

r=interest rate N=pay in period	2%	3%	4%
1	184.451	194.692	202.06
2	178.723	188.151	194.738
3	173.094	181.773	187.65
4	167.564	175.554	180.79
5	162.13	169.49	174.149
6	156.791	163.49	167.719
7	151.544	157.811	161.494
8	146.389	152.188	155.466
9	141.323	146.704	149.628
10	136.343	141.356	143.975
15	112.716	116.322	118.252
20	91.0545	94.5738	96.2688

TABLE III-12

PRESENT VALUE OF REAL COSTS OF TRUST FUND AS A PERCENTAGE OF CLOSURE COST ESTIMATE (30 YEAR SITE LIFE (T), 0% INFLATION)

r=interest rate N=pay in period	2%	3%	4%
1	85.6634	111.777	130.643
2	83.7412	108.949	126.945
3	81.844	106.177	123.342
4	79.9715	103.457	119.83
5	78.1234	100.791	116.409
6	76.2993	98.1755	113.074
7	74.499	95.6105	109.823
8	72.7221	93.0947	106.654
9	70.9681	90.6271	103.565
10	69.2368	88.2065	100.554
15	60.9087	76.7749	86.581
20	53.0996	66.3772	74.2392

TABLE III-13

PRESENT VALUE OF REAL COSTS OF TRUST FUND AS A PERCENTAGE OF CLOSURE COST ESTIMATE (30 YEAR SITE LIFE (T), 8% INFLATION)

r=interest rate N=pay in period	2%	3%	4%
1	256.992	260.814	261.287
2	251.263	254.272	253.965
3	245.635	247.894	246.877
4	240.104	241.675	240.017
5	234.67	235.612	233.376
6	229.331	229.699	226.946
7	224.084	223.933	220.721
8	218.929	218.31	214.693
9	213.863	212.826	208.856
10	208.885	207.477	203.202
15	185.257	182.643	177.479
20	163.595	160.695	155.496

IV. RESULTS OF THE COST MODEL FOR CLOSURE AND POST-CLOSURE REQUIREMENTS

A. Direct Public and Private Costs

1. Results of the Analysis

Table IV-1 lists the direct public and private costs of selected financial tests for closure and post-closure derived by applying the values of the variables to the cost model described in Sections II and III. These results were based on the assumption that all firms being considered have a minimum of $10 million in net worth and are independently audited. The results reflect all costs for all firms considered: that is, either a firm passes a given test and thus uses a financial test as evidence of financial assurance or fails the test and uses a letter of credit.

The tests are initially divided into two groups, those measuring costs of tests with a one-year eligibility period and those with a three-year eligibility period. The eligibility period is the number of consecutive years that a firm must satisfy the criteria of a specific test before the firm may use the test to provide assurance of financial responsibility.

All the tests considered include a requirement of at least $10 million in net worth, and net worth and net working capital at least six times closure and post-closure costs. A full description of the components of each of the tests is provided in Appendix A. Several tests employ a non-numerical identification. They are defined as follows: "Ability to Pay" is a test which requires $10 million in net worth and net worth and net working capital each greater than six times closure

Reproduced from best available copy.

TABLE IV-1

PUBLIC AND PRIVATE COSTS OF SELECTED FINANCIAL TESTS FOR CLOSURE AND POST-CLOSURE

(In thousands of 1980 dollars per year)

Test Description	Eligibility Requirement (one year or three year)	Direct Public Costs Due to Failure of Firms Using a Financial Test	Direct Public Costs Due to Failure of Firms Using a Letter of Credit	Total Direct Public Costs	Private Costs of a Financial Test	Private Costs of a Letter of Credit	Total Private Costs	Sum of Direct Public and Private Costs
No Financial Test	NA	0	142	142	0	3,334	3,334	3,476
139	1	0	142	142	123	1,701	1,824	1,966
125	3	19	137	156	141	1,467	1,608	1,764
138	3	31	134	165	168	1,100	1,268	1,433
127	3	24	136	160	161	1,201	1,362	1,522
138	1	51	129	180	191	800	991	1,171
151	1	68	124	192	193	767	960	1,152
134	1	87	119	206	199	700	899	1,105
136	3	106	114	220	206	600	806	1,026
135	1	112	112	224	208	567	775	999
139	1	125	109	234	219	434	653	887
136	1	169	97	266	224	367	591	857
137	1	201	88	289	231	267	498	787
98	1	207	86	293	234	233	467	760
156	1	225	82	307	239	167	406	713
160	1	232	86	318	241	133	374	698
Inability to Pass Test	3	439	24	463	249	33	282	745
Ability to Pass Test	1	484	12	496	251	0	251	747
May 19, 1980 Test	1 1/	366	44	401	244	100	344	745

1/ May 19, 1980, [illegible] requirement.

and post-closure costs: "No Financial Test" precludes any firm from using a financial test and assumes that all firms will use a letter of credit: and the "May 19, 1980 Test" is the reproposed financial test issued on that date requiring at least $10 million in net worth in the United States, a total liabilities to net worth ratio of not greater than three, and net working capital in the United States equal to at least twice the estimated closure and post-closure obligations of the owner or operator.

The Agency considered two major categories of costs: direct public costs and private costs. From the standpoint of direct public costs, the lowest direct public costs will result from either allowing no financial test or choosing the most stringent test, Test 139 (one-year). Because Test 139 (one-year) passes no firms which will later enter bankruptcy without providing alternative financial assurance, the direct public costs of this test are the same as allowing no financial test. The direct public costs will increase as the tests become less stringent. The direct public costs of the most restrictive Test 139 (one-year) are $142,000, compared with $496,000, the direct public costs of the least restrictive Ability to Pay Test (one-year).

The private costs of the alternative financial tests, on the other hand, decrease dramatically with less stringent tests, because more firms are allowed to use a financial test as evidence of financial responsibility and are not required to obtain one of the more expensive financial mechanisms. If no financial test is allowed, the private costs are $3,334,000. The most restrictive Test 139 (one-year) incurs private costs of $1,824,000, which are significantly higher than those of the least stringent Ability to Pay Test (one-year) with private costs of only $251,000.

In addition to identifying those financial tests which provided the lowest direct public costs and the lowest private costs to the regulated community, the Agency also considered which financial test minimizes the sum of those costs.

Test 100 (one-year) minimizes the sum of direct public and private costs. This test results in a total of direct public and private costs of $688,000, which is $59,000 less than the total annual direct public and private costs associated with the Ability to Pay Test (one-year eligibility).[1] The total of direct public and private costs of not allowing a financial test is five times greater than the costs of Test 100 (one-year). The sum of direct public costs and private costs for the May 19, 1980 Test (one-year) is $745,000, which is $57,000 per year higher than Test 100 (one-year). A comparison of Test 139 (one-year), which minimizes direct public costs, and Test 100 (one-year), which minimizes the sum of direct public and private costs, shows that the savings of $172,000 per year in direct public costs from adopting Test 139 (one-year) would cost the regulated community an additional $1,278,000 in private costs per year.

---

[1] The difference in costs between the Ability to Pay Test with a one-year eligibility requirement and the Test with a three-year eligibility requirement is minimal: for the sum of public and private costs, there is only a difference of $2,000.

2. Other Factors

The costs of various tests presented in Section IV.A.1. show that Test 100 with a one-year eligibility requirement is the test which minimizes the sum of direct public and private costs. However, factors other than costs, such as administrative concerns and the number of bankruptcy proceedings potentially resulting from the use of a particular test, may need to be considered in determining which test to adopt. Also, as shown in the next Section (Section IV.B.), the superiority of Test 100 (one-year) to the Ability to Pay Test (one-year) is very sensitive to uncertainties in the cost model assumptions. As a result, it is useful to compare aspects of these two tests in addition to the question of which test minimizes the sum of direct public and private costs.

The chief non-cost advantage of the Ability to Pay Test (one-year) is that of greater simplicity. By excluding all ratio components, this test would result in much shorter reporting forms, and simpler reporting requirements. The chief disadvantage of this test is that extremely high failure rates are associated with the additional firms which pass this test but do not pass Test 100 (one-year). Table IV-2 compares the number and characteristics of firms which pass Test 100 (one-year) and those which pass the less stringent Ability to Pay Test (one-year) but do not pass Test 100 (one-year). The Ability to Pay Test (one-year) allows only 102 more facilities to be covered by a financial test than were included by Test 100 (one-year). These additional firms, however, are extremely failure-prone. The failure rate of these 102 firms which pass the test and later entering bankruptcy without establishing an

TABLE IV-2

CHARACTERISTICS OF FIRMS THAT PASS TEST 100 (ONE-YEAR) AND OF FIRMS THAT PASS THE LESS STRINGENT ABILITY TO PAY TEST (ONE-YEAR)

	Firms That Pass Test 100 (One-Year)	Firms That Pass an Ability to Pay Test (One-Year) That Would Not Pass Test 100 (One-Year)
Number of facilities affected	2,448	102
Number of firms per 10,000 per year that pass the test and will go bankrupt without providing alternative financial assurance	10.1	252
Number of facilities failing per year	2.5	2.6
Number of bankruptcy proceedings per year	.6	.7

alternative financial mechanism is about 252 per 10,000 per year (2.5 percent per year). As a result of this high failure rate, the total number of facilities owned by bankrupt firms doubles, even though only 102 additional firms (a 4 percent increase) were added to the set of firms able to pass the test. The Agency will also have to enter into twice as many bankruptcy proceedings each year using the Ability to Pay Test (one-year). The estimates of the number of bankruptcy proceedings per year are based on the assumption that the average firm with over $10 million in net worth will own four facilities. Thus, the number of bankruptcy proceedings per year is equal to one-fourth of the number of facilities that fail per year.

B. Sensitivity Analysis

The purpose of the sensitivity analysis is to determine how sensitive the results of the analysis are to the assumptions employed. The purpose of this analysis is not to determine in absolute terms how changes in assumptions will change the costs of specific tests but rather whether changes in assumptions will affect the choice of test. By examining the results of the various tests in Table IV-1, it is clear that if the direct public costs of Test 100 (one-year) were increased by $60,000 and the costs of all of the other tests remained unchanged, Test 100 (one-year) would become significantly inferior to Test 146 (one-year), the Ability to Pay Test (both one- and three-year), and the May 19, 1980 Test. However, there are no cost assumptions in the model which will affect only the costs of Test 100 (one-year) and not the costs of all of the other tests. In fact, the values used to calculate the costs apply equally to all tests, and because the model is linear, changes in assumptions will affect the results of all tests proportionally. Therefore, this sensitivity analysis will focus on the percentage changes in costs required for all tests to change the choice of test which minimizes the sum of direct public and private costs. For example, if different assumptions about direct public costs resulted in all direct public costs for all tests being increased 100 times the current estimates but the private costs remained unchanged, a more stringent test would be chosen if the goal is to minimize the sum of public and private costs.

a. Sensitivity of the Cost Estimation Assumptions

This sensitivity analysis evaluates how sensitive Test 100 (one-year) is to the specific assumptions of the cost model. In this Section, the analysis retains the $10 million in net worth requirement; the effect of deleting this requirement is discussed in Section IV.C. The results cited in Section IV.A. are sensitive to two different types of uncertainties: (1) uncertainty as to the accuracy of the cost estimation assumptions, and (2) uncertainty with respect to the measurements used to predict the performances of a given test.

This analysis tests the sensitivity of the cost estimation assumptions assuming that the values of E_P and A_{NB} remain unchanged.

The results of this sensitivity analysis are shown in Table IV-3. This Table records for each major cost element and for the totals of direct public and private costs the percentage change in costs required to make the test in the Table dominant over Test 100 (one-year), that

TABLE IV-3

SENSITIVITY OF TEST 100 (ONE-YEAR) AS THE TEST THAT MINIMIZES THE SUM OF DIRECT PUBLIC AND PRIVATE COSTS OF CLOSURE AND POST-CLOSURE TO ASSUMPTIONS OF THE COST MODEL

Reproduced from best available copy.

Test Description	Percentage Change[1/] Required in Direct Public Costs Due to Failure of Firms Using a Financial Test	Percentage Change Required in Direct Public Costs Due to Failure of Firms Using a Letter of Credit	Percentage Change Required in Total Direct Public Costs	Percentage Change Required in Private Costs of a Financial Test	Percentage Change Required in Private Costs of a Letter of Credit	Percentage Change Required in Total Private Costs
No Financial Test	1,191	Completely Insensitive	1,621	1,157	-87	-94
139 (one-year eligibility requirement)	546	Completely Insensitive	743	1,083	-82	-88
146 (one-year eligibility requirement)	278	Completely Insensitive	357	1,250	-74	-78
Ability to Pay Test (one-year eligibility requirement)	-24	88	-32	Completely Insensitive	44	48

[1/] The percentage change required for any given cost element represents the percentage change in costs required for all tests to change the choice of test which minimizes the sum of direct public and private costs.

is, making it the test that minimizes the sum of direct public and private costs. The tests chosen to compare with Test 100 (one-year), the test which minimizes the sum of direct public and private costs, were the following: No Financial Test; Test 139 (one-year), the test with the lowest direct public costs; and Test 146 (one-year) and the Ability to Pay Test (one-year), the two tests closest in costs to Test 100 (one-year). (The costs of the one-year and three-year Ability to Pay Tests are nearly identical; for this analysis, the one-year test is used.)

As shown in the Table, for No Financial Test to become the test which minimizes the sum of direct public and private costs, the direct public costs due to failure of firms using a financial test would have to increase 1191 percent for all tests. For the Ability to Pay Test (one-year) to be the test that minimizes the sum of direct public and private costs, direct public costs due to failure of firms using a financial test would have to decrease 24 percent for all tests. The entries which are listed as completely insensitive indicate that it is impossible to change the costs of that cost element enough to make the sum of direct public and private costs less than those of Test 100 (one-year).

The results of Test 100 (one-year) are relatively insensitive to uncertainties in the assumptions of the major cost elements. As shown in the Table, most of the cost elements would require percentage changes in the values of the underlying variables beyond the reasonable ranges of uncertainty. The exception to this is the Ability to Pay Test (one-year). If direct public costs due to failure of firms using a financial test are 24 percent lower for all tests than originally estimated, or the total direct public costs are 32 percent lower for all tests, then the sum of direct public and private costs of the Ability to Pay Test (one-year) would be less than those of Test 100 (one-year). Errors of this size are possible to the extent that the failure rate for firms of over $10 million in net worth that are independently audited has been overestimated and to the extent that significantly higher recovery rates than assumed here are possible. The Ability to Pay Test (one-year) would also become the test which minimizes the sum of direct public and private costs if the private costs associated with letters of credit were 44 percent higher for all tests, a figure well within the range discussed in Section III.

Firms which fail a financial test may be unable to obtain a letter of credit and would be forced to use a trust fund, a more expensive instrument. In order to determine how the use of trust funds would affect the costs, the Agency performed an analysis assuming that firms which failed the financial test would use trust funds rather than letters of credit. The direct public and private costs of a letter of credit remain the same as in the original analysis. The direct public costs of a trust fund are similar to those for a letter of credit: while the trust fund poses a greater potential for direct public costs during the build-up period of the fund, it will result in lower direct public costs after the fund is fully paid than the letter of credit. (The size of the trust fund may be adjusted for inflation: therefore, delayed payments and failure to adjust the amount of available funds for inflation during post-closure, which are major sources of direct public costs for a letter of credit, are not significant sources of direct public costs for trust funds.) Based on the analysis described in Section III.F., the average costs of a trust fund will be 7.8 percent of closure and post-closure costs annually over the life of the facility.

If all firms that cannot pass Test 100 (one-year) with a $10 million in net worth requirement must use a trust fund, then the private costs for firms that fail this test will increase from $133,000 per year to $1,448,000 per year, and the sum of direct public and private costs will increase to $2,003,000. The private costs, and the sum of direct public and private costs, for the Ability to Pay Test (one-year) with a $10 million in net worth requirement remain unchanged, since all firms pass this test and none are forced to use trust funds. As a result, the sum of direct public and private costs of the Ability to Pay Test (one-year) with a $10 million in net worth requirement are $1,256,000 per year lower than the total costs of Test 100 (one-year) with a $10 million in net worth requirement. If even 4.5 percent of the firms which fail Test 100 (one-year) without a $10 million in net worth requirement use a trust fund, then the Ability to Pay Test (one-year) without a $10 million in net worth requirement will be the test that minimizes the sum of direct public and private costs.

It should be noted, however, that most of these additional private costs of trust funds are not costs to the economy as a whole, as are the costs of the other financial mechanisms, but are transfer payments. All costs except trustee fees result from either (1) costs due to a lower rate of return on the trust fund than the average corporate rate of return, and (2) federal taxes on the trust fund. The need to use low rate of return securities ultimately provides investment funds for other firms, either directly through purchase of corporate stocks and bonds or indirectly by reducing the amount of funds to the private sector diverted by government bonds. The increased taxes due to the use of a trust fund are a transfer payment to the Federal government. As a result, the purchasing power is not lost to the economy.

The decision to select a test which minimizes the sum of direct public and private costs is justified in part by the argument that the public will ultimately pay both forms of costs. This argument, however, does not apply to the transfer payment portion of the trust fund costs. While the costs of a trust fund will be passed on to the public, the public will receive most of these costs back in the form of increased federal tax collections and lower cost availability of investment for other purposes. As a result, if the purpose of minimizing the sum of direct public and private costs is to minimize the costs ultimately borne by the public, then most of the private costs associated with trust funds should not be included. This is not true of the costs of a letter of credit, however. The Agency has stated in the Regulatory Impact Analysis of the financial responsibility regulations that only 6 percent of the private costs of a letter of credit represent transfer payments.

If only the costs of trustee fees are included as private costs, then the private costs of a trust fund are approximately the same as private costs of a letter of credit. Therefore, the sum of direct public and private costs of Test 100 (one-year) with a $10 million in net worth requirement are lower than those of the Ability to Pay Test (one-year) with a $10 million in net worth requirement.

b. Sensitivity of the Measurements of Test Performance

As noted in Appendix A, the differences between the performances of several of the tests, particularly Tests 100, 146, 98, and 137, all as one-year tests, are extremely small with respect to both E_P and A_{NB}. For example, if the values of E_P and A_{NB} of the tests were applied only to the holdout sample, Test 137 (one-year) would dominate Test 100 (one-year). The basic problem is that there are not statistically significant differences between the performances of these tests. However, Test 100 (one-year) is the test which minimizes the sum of public costs using the values of E_P and A_{NB} for both the primary sample and the average of the combined primary and holdout samples. Thus, it is reasonable to conclude that Test 100 (one-year), among all of the tests examined, is the test which minimizes the sum of public and private costs.

As noted in Section I.B., the effect of the multiple portion of the test is not included in the measurement of either A_{NB} or E_P. Failure to include these multiples in the measurement of A_{NB} results in an overestimation of costs associated with firms passing a financial test. This results because at least a few firms that are counted as passing the test would be firms with relatively small net worth and very high closure and post-closure costs which in fact fail the multiple portion of the test. E_p would be somewhat underestimated because it does not include the ability of the multiples to discriminate against potentially bankrupt firms. The combined effect of this is that total direct public costs are somewhat overestimated and private costs are consistently somewhat underestimated.

c. Alternative Assumptions About the Percentage of Firms that are Independently Audited

The cost analysis discussed in the previous sections only includes the costs to facilities that are owned by firms that are independently audited. The accuracy of these estimates will depend on the accuracy of the assumptions about the percentage of firms of over $10 million in net worth that are independently audited and the percentage of firms with less than $10 million in net worth that are guaranteed by firms of greater than $10 million in net worth and independently audited. An analysis of the sensitivity of these assumptions is included in Section IV.C.5.

C. Analysis of the $10 Million in Net Worth Requirement

The initial goal of the analysis presented in Appendices A and B was to determine which financial tests would correctly identify firms which would later go bankrupt. A $10 million in net worth requirement is an important element of a test with that goal. As a result of a suggestion that a test that minimized the sum of public and private costs might be as important as a test's ability correctly to predict future bankruptcy, the Agency reexamined the $10 million in net worth requirement and the effect that its elimination would have on the direct public costs and private costs of alternative financial tests. A new set of financial tests was introduced which eliminated the $10 million in net worth requirement. These new tests were composed of all of the same ratios as the tests with the $10 million in net worth requirement. They also included the requirement that net worth and net working capital each exceed six times closure and post-closure costs. This analysis of financial tests without a $10 million in net worth requirement is divided into five sections: (1) Analytic Approach: (2) Changes in the Values of Variables: (3) Direct Public and Private Costs: (4) Other Factors: and (5) Sensitivity Analysis.

1. Analytic Approach

In order to determine the direct public costs and private costs of the financial tests without a $10 million in net worth requirement, the Agency had to expand the set of firms analyzed to include all firms regardless of their size. The values of the variables in the supporting equations in Section II had to be altered to reflect the fact that a $10 million in net worth requirement was no longer present. The direct public and private costs of a given test including a $10 million in net worth requirement are the sum of the costs reported in Section IV.A. for all firms with greater than $10 million in net worth and independently audited and the costs assuming no financial test is allowed for firms with less than $10 million in net worth. The direct public and private costs of a given financial test without a $10 million in net worth requirement are the sum of the costs reported in Table IV-1 for firms with greater than $10 million in net worth and independently audited and the costs of the given test using the summary and supporting equations of Section II with altered variables (see Section IV.C.2.) for firms with less than $10 million in net worth.

The steps used to compute costs for firms with less than $10 million in net worth are as follows:

(1) Revise the value of E (number of firms per 10,000 that pass a given financial test that will go bankrupt without providing alternative financial assurance) for each test considered, to reflect the higher bankruptcy rate for firms with less than $10 million dollars in net worth.

(2) Assume that A_{NB} is the same for both firms of greater than $10 million in net worth and less than $10 million in net worth. This assumption ignores the likelihood that a higher percentage of small firms will fail the multiples portion of the test.

(3) Revise the value of N (the number of facilities by facility type owned by firms of over $10 million in net worth that are independently audited) to reflect the estimate in Section III that only 2.7 percent of firms with less than $10 million in net worth are independently audited.

(4) Revise the value of R_{CP} (share of closure and post-closure costs not recovered from bankruptcy proceedings), revise the value of C_A (private costs of auditor's special report/facility/year), and incorporate a revised fee structure for a letter of credit into the calculation of C_L (annualized private costs of fees for a letter of credit/facility/

year of facility life). It is still assumed that firms which fail the financial test will use a letter of credit, although this is less true for firms without $10 million in net worth than it is for firms having $10 million in net worth.

(5) Recompute the direct public costs and private costs of a given financial test using the equations of Section II with the revised variable values discussed in steps 1 and 3 above.

2. Changes in the Values of Variables

Table IV-4 presents the revised values of variables used to compute the direct public costs and private costs of tests excluding the $10 million in net worth requirement.

The failure rate for firms with less than $10 million in net worth was assumed to be 62 per 10,000. The average long-term business failure rate for all firms is 44 per 10,000 according to Dun and Bradstreet data (see Appendix A). Small firms owning TSDFs, however, are likely to have a much higher rate of business failure because of the unusual risks and potential costly expenditures such as cleanup expenditures, liability judgments and premature closure of a facility which may occur over the life of the facility. Although the estimate of 62 per 10,000 is highly uncertain, the Agency felt that it was necessary to take the effect of unexpected large expenditures into account when considering the failure rate of small firms owning TSDFs.

R_{CP}, the share of closure and post-closure costs not recovered from bankruptcy proceedings, was increased from .4 to .75 for firms with less than $10 million in net worth. This reflects the fact that smaller

TABLE IV-4

VALUES OF VARIABLES USED IN ESTIMATING DIRECT PUBLIC AND PRIVATE COSTS FOR FIRMS WITH LESS THAN $10 MILLION IN NET WORTH

Failure rate for all firms to which analysis is applied (F)	62/10,000
Share of closure and post-closure costs not recovered from bankruptcy proceedings (R_{CP})	.75
Fees for letter of credit (C_{LS} and C_{LP})	1.5%
Private costs of auditor's special report/facility/year (C_A)	$300

firms are much more likely to liquidate rather than reorganize, and that even when they do reorganize it will be more difficult to collect necessary funds.

The value of C_A was assumed to equal $300 per year to reflect the elimination of the net worth requirement. Although the cost of a special report will not vary with the size of the firm, it represents a fee that must be distributed on a per facility basis. The cost of C_A per facility therefore increases as the number of facilities owned by a firm decreases. Unfortunately, there are little or no data concerning the average number of facilities owned by smaller firms. For the purpose of this analysis, it was assumed that firms with a minimum of $10 million in net worth own or operate an average of four facilities while firms without $10 million in net worth own or operate an average of one facility. It was still assumed that 34 percent of all firms with greater than $10 million in net worth and 2.7 percent of all firms with less than $10 million in net worth are independently audited.

The fees for a letter of credit were considered to be 1.5 percent of the face value of the credit for firms not having $10 million in net worth. In addition to higher costs, issuing institutions may require collateral from smaller firms for the letter of credit. It is also possible that some firms passing a test without a $10 million in net worth requirement would otherwise have had to use a trust fund. Because both of these possibilities would require complete reanalysis of the public and private costs of alternative financial tests, they were not taken into account.

3. Results of This Analysis

Table IV-5 compares the costs of alternate tests with and without the $10 million in net worth requirement. It should be noted that results here, particularly for the tests with the $10 million in net worth requirement, are different from those reported elsewhere in this report because the costs of all firms that are independently audited and not just those with greater than $10 million in net worth and independently audited are included. To derive the costs of tests that have a $10 million in net worth requirement, it is assumed that all firms which cannot meet this criterion use a letter of credit.

In this analysis, the Test which minimizes the sum of public and private costs is Test 100 (one-year) without the $10 million in net worth requirement. This test has total public and private costs of $929,000 per year. The total direct public costs for this test are $446,000 per year and the total private costs are $483,000 per year. By comparison, Test 100 (one-year) with the $10 million in net worth requirement has a sum of public and private costs of $1,807,000 per year, with $374,000 in direct public costs and $1,433,000 per year in private costs.

Test 100 (one-year) without the $10 million in net worth requirement dominates the Ability to Pay Test (one-year). It also has the advantage of having significantly lower direct public costs. Test 146 (one-year) is, however, extremely close in performance to Test 100 (one-year) without the $10 million in net worth requirement. The direct public costs of Test 146 are $11,000 lower than Test 100 (one-year) but

Reproduced from best available copy.

TABLE IV-5

PERFORMANCE AND DIRECT PUBLIC AND PRIVATE COSTS OF ALTERNATIVE FINANCIAL TESTS FOR CLOSURE AND POST-CLOSURE

(in thousands of 1980 dollars per year)

Test Description	Eligibility Requirement (one year or three year)	E_P	A_{NR}	Direct Public Costs Due to Failure of Firms Using a Financial Test	Direct Public Costs Due to Failure of Firms Using a Letter of Credit	Total Direct Public Costs	Private Costs of a Financial Test	Private Costs of a Letter of Credit	Total Private Costs	Sum of Direct Public and Private Costs
No Financial Test	NA	NA	0	0	202	202	0	4,393	4,393	4,595
Test 139 (With $10 Million Net Worth Requirement)	1	0	46	0	202	202	123	2,760	2,883	3,085
Test 100 (With $10 Million Net Worth Requirement)	1	10.1	89	234	140	374	241	1,192	1,433	1,807
May 19, 1980 Test (With $10 Million Net Worth Requirement)	1[1/]	15.7	90	366	104	470	244	1,159	1,403	1,873
Test 139 (Without $10 Million Net Worth Requirement)	1	0	49	0	202	202	162	2,106	2,268	2,470
Test 146 (Without $10 Million Net Worth Requirement)	1	11.2	95	319	116	435	315	207	522	957
Test 100 (Without $10 Million Net Worth Requirement)	1	11.4	96	332	114	446	318	165	483	929
Ability to Pay Test (Without $10 Million Net Worth Requirement)	1	22.8	100	687	17	704	331	0	331	1,035
Ability to Pay Test (Without $10 Million Net Worth Requirement)	3	20.9	99	623	34	657	328	41	369	1,026

[1/] The May 19, 1980 proposed test had a one-year eligibility requirement.

the total of direct public and private costs of Test 146 (one-year) exceed Test 100 (one-year) by $28,000.

4. Other Factors

The previous Section demonstrated that a $10 million in net worth requirement will not result in a test that minimizes the sum of direct public and private costs. The next section will show that the results of Test 100 (one-year), the test that minimizes the sum of public and private costs, are very sensitive to alternative assumptions in the cost model, and that under a variety of possible cost assumptions, an Ability to Pay Test (one-year) would minimize the sum of public and private costs. The purpose of this section is to examine certain non-cost factors which might influence the choice of tests and the decision to include or exclude a $10 million in net worth requirement.

Table IV-6 compares the non-cost factors of three tests which are characterized by different degrees of stringency. The purpose of this Table is to compare the characteristics of firms which pass Test 100 (one-year) with a $10 million in net worth requirement to the characteristics of firms which pass two successively less stringent tests, Test 100 (one-year) without a $10 million in net worth requirement and the Ability to Pay Test (one-year).

Eliminating the $10 million in net worth requirement from Test 100 (one-year) allows an additional 194 facilities to be covered by a financial test (an increase of 8 percent over the use of Test 100 (one-year) with a $10 million in net worth requirement). However, as a result of the higher failure rate (28.5 per 10,000 firms versus 10.1 per 10,000),

Reproduced from best available copy.

TABLE IV-6

CHARACTERISTICS OF FIRMS THAT PASS SUCCESSIVELY LESS STRINGENT TESTS

	Firms That Pass Test 100 (One-Year) With a $10 Million Net Worth Requirement	Firms That Pass Test 100 (One-Year) Without a $10 Million Net Worth Requirement That Would Not Pass Test 100 With a $10 Million Net Worth Requirement	Firms That Pass an Ability to Pay Test (One-Year) Without a $10 Million Net Worth Requirement That Would Not Pass Test 100 Without a $10 Million Net Worth Requirement
Number of facilities affected	2,448	194	110
Number of firms per 10,000 per year that pass the test and will go bankrupt without providing alternative financial assurance	10.1	28.5	285
Number of facilities failing per year[1/]	2.5	.6	3.1
Number of bankruptcy proceedings per year[2/]	.6	.6	1.2
Percentage of closure and post-closure costs not recovered in bankruptcy proceedings	40%	75%	46%

[1/] The number of facilities failing per year is derived by applying the failure rate listed above for the given test to the number of facilities affected.

[2/] The number of bankruptcy proceedings is based on the assumption that firms of greater than $10 million in net worth own an average of four facilities and firms of less than $10 million in net worth own an average of one.

adding 194 facilities will also result in a 24 percent increase in the number of facilities that will fail per year; that is, an additional .6 facilities over the baseline 2.5 failures will fail as a result of eliminating the $10 million in net worth requirement from Test 100 (one-year). The number of bankruptcy proceedings, which is a function of the number of facilities failing per year and the number of facilities owned per firm, will increase by 100 percent if the $10 million in net worth requirement is eliminated from Test 100 (one-year). (It is assumed that the average firm of greater than $10 million in net worth will own four facilities and the average firm with less than $10 million in net worth will own one facility.) The recovery rate in bankruptcy proceedings for these additional facilities which will fail is also significantly lower if the $10 million in net worth requirement is eliminated.

The analysis of non-cost factors relevant to a comparison of the characteristics of firms which pass Test 100 (one-year) with and without a $10 million in net worth requirement assumes that no firms will obtain an independent audit for the sole purpose of being eligible for the financial test. Two groups of firms, however, that might find it in their interest to obtain an independent audit in order to be able to use a financial test are: (1) firms that would otherwise have to use a trust fund rather than a financial test, and (2) firms purposely attempting to avoid financial responsibility requirements by fraudulent means. Both of these groups can be expected to have somewhat higher failure rates than the typical small firm.

As noted in Section I, most firms of under $10 million in net worth would find it less expensive to use a letter of credit than obtain an independent audit. For firms that own large facilities but cannot obtain a letter of credit, however, the costs of an audit would be lower than the costs of a trust fund. To the extent that this is the case, firms with higher than average failure rates would be added to the set of firms using a financial test. If the worst 10 percent of firms with under $10 million in net worth obtained audits for the purpose of using a financial test, the average failure rate of firms using a financial test would rise to 1.1 percent,[1] with a proportionate increase in the number of facility failures and bankruptcies. These events are less likely for firms of over $10 million in tangible net worth because of the increasing costs of an independent audit.

Firms wishing fraudulently to avoid financial responsibility requirements might purposely set up their books to meet the financial test requirements and obtain an independent audit. Such an approach might work to the extent that an auditor was obtained who was willing to accept these books, or to the extent that the fraud deceived an independent auditor. This would be less likely with a $10 million in tangible net worth requirement, because such a value can be easily checked by either an independent auditor or by the EPA. Sensitivity analysis shows that if as few as three such frauds were successful per year, however, a test without a $10 million in net worth requirement would no longer be the test that minimized the sum of public and private costs. Because fraudulent abandonments are more likely to lead to excessive closure costs, an even lower number of fraudulent abandonments per year would change this result.

---

[1] Based upon the failure rate of small firms which pass Test 100 but fail Test 149.

Selection of the least stringent Ability to Pay Test (one-year) rather than Test 100 (one-year) without the $10 million in net worth requirement allows an even more failure-prone group of firms to use a financial test. The Ability to Pay Test (one-year) only includes 110 more facilities than Test 100 (one-year) without the $10 million in net worth requirement: however, these firms will fail at a rate of 285 per 10,000 (2.85 percent failure rate). In addition, the number of facilities which will fail and the number of bankruptcy proceedings per year will double as a result of using the Ability to Pay Test (one-year) (i.e., 3.1 facilities will fail as a result of the Ability to Pay Test (one-year) in addition to the 3.1 facilities that will fail under the two more stringent tests). The estimated recovery rate in these additional bankruptcy proceedings is 54 percent. This estimate assumes that a weighted combination of large and small firms will be represented in the bankruptcy proceedings. Since the additional firms included by the Ability to Pay Test will be firms that fail the financial ratio components of Test 100 (one-year) and not ones that were excluded solely because of the $10 million in net worth requirement (these firms would have already been included in the number of additional firms admitted by Test 100 (one-year) without a net worth requirement), the additional firms included with the Ability to Pay Test (one-year) will likely be weighted towards large firms.

5. Sensitivity Analysis

A sensitivity analysis of the type discussed in Section IV.B. was also conducted to determine how sensitive the results of Test 100 (one-year), the test that minimizes the sum of public and private costs without a $10 million in net worth requirement, are to the assumptions in the model. This analysis does not take into account the effect of non-cost factors discussed in Section IV.C.4. The results of this analysis are shown in Table IV-7. This Table records for each major cost element and for total direct public and private costs of various tests the percentage change in costs required to make that test dominant over Test 100 (one-year) without a $10 million in net worth requirement, that is, to make it the test that minimizes the sum of direct public and private costs. The tests chosen to compare to Test 100 (one-year) without the $10 million in net worth requirement are: Ability to Pay Test (one-year) without the $10 million in net worth requirement, No Financial Test, Test 146 (one-year) without the $10 million in net worth requirement, and Test 100 (one-year) with a $10 million in net worth requirement.

a. Sensitivity of the Cost Estimation Assumptions

This analysis indicates that it is unlikely that a test more stringent than Test 100 (one-year) without a $10 million in net worth requirement would minimize the sum of direct public and private costs. The more stringent Test 146 (one-year) without a $10 million in net worth requirement requires a relatively small percentage change in the private costs of a letter of credit to make it the test which minimizes

400

TABLE IV-7

SENSITIVITY OF TEST 100 (ONE-YEAR) WITHOUT A $10 MILLION IN NET WORTH REQUIREMENT THAT MINIMIZES THE SUM OF DIRECT PUBLIC AND PRIVATE COSTS OF CLOSURE AND POST-CLOSURE TO ASSUMPTIONS OF THE COST MODEL

Test Description	Percentage Change[1] Required in Direct Public Costs Due to Failure of Firms Using a Financial Test	Percentage Change Required in Direct Public Costs Due to Failure of Firms Using a Letter of Credit	Percentage Change Required in Total Direct Public Costs	Percentage Change Required in Private Costs of a Financial Test	Percentage Change Required in Private Costs of a Letter of Credit	Percentage Change Required in Total Private Costs
Ability to Pay Test (one-year eligibility requirement; without $10 million net worth requirement)	-30	109	-41	Completely Insensitive	64	70
No Financial Test	1,104	Completely Insensitive	1,502	1,153	-87	-94
Test 146 (one-year eligibility requirement; without $10 million net worth requirement)	215	Completely Insensitive	255	933	-67	-72
Test 100 (one-year eligibility requirement; with $10 million net worth requirement)	896	Completely Insensitive	1,219	1,140	-85	-92

---

[1] The percentage change required for any given cost element represents the percentage change in costs required for all tests to change the choice of test which minimizes the sum of direct public and private costs.

Reproduced from best available copy.

the sum of direct public and private costs; however, this test would require that the average cost of a letter of credit be reduced to 0.2 percent of the value of closure and post-closure costs for it to be the test which minimizes the sum of direct public and private costs. Such a reduction in the cost of a letter of credit is unlikely, since the firms which fail the financial test and are forced to use a letter of credit tend to be firms that are relatively weak financially.

The choice between Test 100 (one-year) without a $10 million in net worth requirement and the Ability to Pay Test (one-year) without a $10 million in net worth requirement is, however, highly sensitive to a number of cost assumptions. The Ability to Pay Test (one-year) without a $10 million in net worth requirement is the test which minimizes the sum of direct public and private costs if, for example, underestimates of recovery rates or overestimates of failure rates result in small percentage changes in direct public costs. The choice between these two tests is also strongly influenced by the private costs of a letter of credit. An increase of 64 percent in the costs of a letter of credit makes the Ability to Pay Test (one-year) without a $10 million in net worth requirement the test which minimizes the sum of direct public and private costs. As noted in Section III, this higher estimate is within the range of uncertainty associated with costs of letters of credit. Costs of letters of credit may be higher than average for the set of firms that fail Test 100 (one-year) with a $10 million in net worth requirement but pass the Ability to Pay Test (one-year) without a $10 million in net worth requirement because they are weaker financially.

As discussed in Section IV.B., firms which fail a financial test may be unable to obtain a letter of credit and would be forced to use a trust fund, a more expensive instrument. In order to determine how the use of trust funds would affect the costs, the Agency performed a similar analysis to that in Section IV.B. assuming that firms which failed the financial test would use trust funds rather than letters of credit. The direct public and private costs of a letter of credit remain the same as in the original analysis. Based on the analysis described in Section III.F., the average costs of a trust fund will be 7.8 percent of closure and post-closure costs annually over the life of the facility.

If all firms that cannot pass Test 100 (one-year) without a $10 million in net worth requirement must use a trust fund, then the private costs for firms that fail this test will increase from $165,000 per year to $1,797,000 per year, and the sum of direct public and private costs will increase to $2,565,000. The private costs, and the sum of direct public and private costs, for the Ability to Pay Test (one-year) without a $10 million in net worth requirement remain unchanged, since all firms pass this test and none are forced to use trust funds. As a result, the sum of direct public and private costs of the Ability to Pay Test (one-year) without a $10 million in net worth requirement are $1,530,000 per year lower than the total costs of Test 100 (one-year) without a $10 million in net worth requirement. If even 7 percent of the firms which fail Test 100 (one-year) without a $10 million in net worth requirement use a trust fund, then the Ability to Pay Test (one-year) without a $10 million in net worth requirement will be the test that minimizes the sum of direct public and private costs.

As discussed in Section IV.B., most of these additional private costs of trust funds are not costs to the economy as a whole, as are the costs of the other financial mechanisms, but are transfer payments and should not be included as private costs. If only the costs of trustee fees are included as private costs, then the private costs of a trust fund are approximately the same as private costs of letters of credit. Therefore, the sum of direct public and private costs of Test 100 (one-year) without a $10 million in net worth requirement is lower than the sum of those costs of the Ability to Pay Test (one-year) without a $10 million in net worth requirement.

b. Sensitivity of the Measurements of Test Performance

The results of the analysis of Test 100 (one-year) without a $10 million in net worth requirement are sensitive to the same uncertainties with respect to the measurements used to predict test performance as are the results for Test 100 (one-year) (see Section IV.B.). As noted in Appendix A, the differences between performances of several of the tests, particularly Tests 100, 146, and 137, all as one-year tests, are extremely small with respect to both E_P and A_{NB}. For example, if the values of E_P and A_{NB} of the tests were applied to the holdout sample, Test 137 (one-year) would dominate Test 100 (one-year). The basic problem is that there are no statistically significant differences between the performances of these tests. However, Test 100 (one-year) is the test which minimizes the sum of direct public costs using the values of E_P and A_{NB} for both the primary samples and the average of the combined primary and holdout samples. Thus, it is reasonable to conclude that Test 100 (one-year), among all of the tests examined, is the test that minimizes the sum of direct public and private costs.

As noted in Section I.B., the effect of the multiple portion of the test is not included in the measurement of either A_{NB} and E_P. Failure to include these multiples in the measurement of A_{NB} results in an overestimation of costs associated with firms passing a financial test. This results because at least a few firms that are counted as passing the test would be firms with relatively small net worth and very high closure and post-closure costs which in fact fail the multiple portion of the test. E_P would be somewhat underestimated because it does not include the ability of the multiples to discriminate against bankrupt firms. The combined effect of this is that total direct public costs are somewhat overestimated and private costs are somewhat underestimated.

c. Alternative Assumptions about the Percentage of Firms that are Independently Audited

Table IV-8 compares the costs of Test 100 (one-year) for all firms using different assumptions as to the percentage of firms that are independently audited. The cost analysis discussed in all of the previous Sections includes only the costs to facilities owned by firms that are independently audited. The base assumption is that 34 percent of firms of greater than $10 million in net worth and 2.7 percent of firms of less than $10 million in net worth are independently audited. This Table presents the costs of Test 100 (one-year) to all firms,

TABLE IV-8

COSTS FOR ALL FACILITIES OF TEST 100 (ONE-YEAR) USING ALTERNATIVE ASSUMPTIONS AS TO THE PERCENTAGE OF FIRMS INDEPENDENTLY AUDITED (ASSUMING ALL FIRMS NOT INDEPENDENTLY AUDITED USE A LETTER OF CREDIT)

Reproduced from best available copy.

Percentage of Firms Independently Audited		E_F 1/	Percentage of All Facilities that Pass Test 100 (one year)	Direct Public Costs Due to Failure of Firms Using a Financial Test	Direct Public Costs Due to Failure of Firms Using a Letter of Credit	Total Direct Public Costs	Private Costs of a Financial Test	Private Costs of a Letter of Credit	Total Private Costs	Sum of Direct Public and Private Costs
Over $10 Million in Net Worth	Less Than $10 Million in Net Worth									
34	0	10.1	17	234	2,586	2,820	241	46,023	46,264	49,084
34	2.7	11.4	18	332	2,560	2,892	318	44,996	45,314	48,206
100	100.0	19.3	96	4,331	1,499	5,830	4,352	1,658	6,010	11,840
100	0	10.1	48	702	2,462	3,164	723	39,621	40,344	43,508
17	1.35	11.4	9	166	2,604	2,770	160	47,110	47,270	50,040

1/ E_F = the most probable estimate of the number of firms per 10,000 that pass a given financial test that will go bankrupt without providing alternative financial assurance.

Derivation: Uses cost model of Section IV.C.1. and 2., but alters N_i to include all facilities. Facilities not owned by an independently audited firm are assumed to use a Letter of Credit.

including those not independently audited. All firms that are not independently audited are assumed to use a letter of credit. The percentage of facilities that pass Test 100 (one-year) represents the percentage of firms that meet the criteria of Test 100 (one-year) and are independently audited. Therefore, if all firms are independently audited, 96 percent of all facilities will be included by Test 100 (one-year). The percentage of all facilities included by Test 100 (one-year) is then adjusted downward to reflect the different assumptions as to the actual percentage of firms that are independently audited.

As shown in the Table, the sum of direct public and private costs of Test 100 (one-year), assuming that 34 percent of firms with greater than $10 million in net worth and 2.7 percent of firms with less than $10 million in net worth are independently audited, is $38 million. Because only 18 percent of all facilities are included by Test 100 (one-year) under this assumption, the costs are significantly higher than the sum of direct public and private costs if all firms were independently audited (or if this requirement were eliminated).

Assuming that all firms are not independently audited, the accuracy of the percentages used is not very sensitive. If 100 percent of firms of greater than $10 million in net worth and no smaller firms are independently audited, the sum of direct public and private costs is only 12 percent lower than the base estimate. Similarly, if the base estimates are both overestimated by 50 percent, the total costs will only be increased by 5 percent.

416

The assumptions used for the percentage of firms that are independently audited greatly affect the costs associated with a given test: however, because these changes will affect the cost of all tests equally, changes in these assumptions will not affect the choice of the test which minimizes the sum of direct public and private costs.